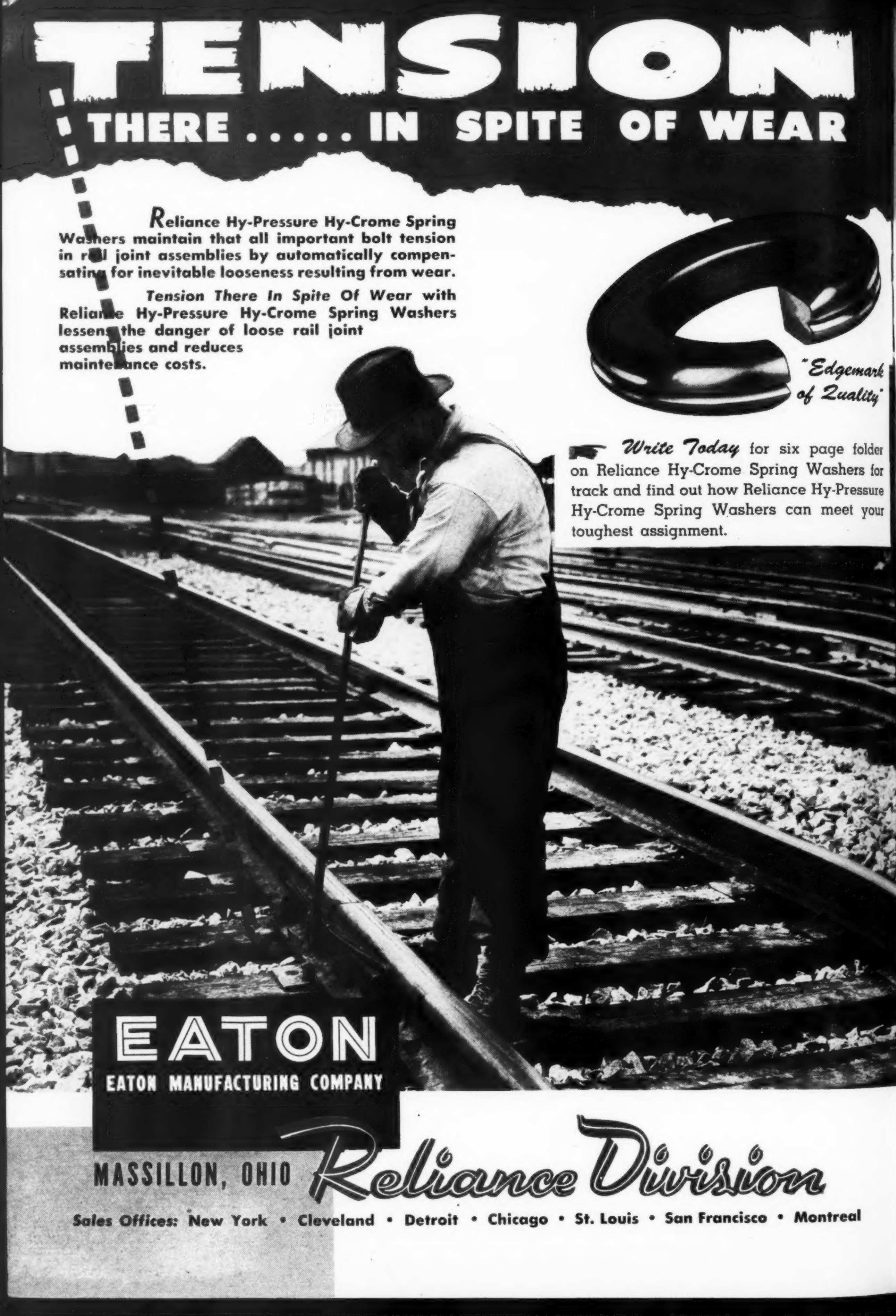
Railway Engineering and Maintenance

In many terminal yards, and on thousands of miles of track across plains and over mountains Improved Hipowers are helping maintain track under the heaviest traffic in railroad history.

They make the track maintenance job far easier.

IMPROVED HIPOWERS
IMPROVE TRACK


TENSION
THERE ..... IN SPITE OF WEAR
Reliance Hy-Pressure Hy-Crome Spring Washers maintain that all important bolt tension in rail joint assemblies by automatically compensating for inevitable looseness resulting from wear.
Tension There In Spite Of Wear with Reliance Hy-Pressure Hy-Crome Spring Washers lessens the danger of loose rail joint assemblies and reduces maintenance costs.
"Edgemark of Quality"
Write Today for six page folder on Reliance Hy-Crome Spring Washers for track and find out how Reliance Hy-Pressure Hy-Crome Spring Washers can meet your toughest assignment.
EATON
EATON MANUFACTURING COMPANY
MASSILLON, OHIO
Reliance Division
Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago 3, Ill. Subscription price: United States and Possessions, and Canada, $2.00; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933 at the post office at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., post office. Address communications to 105 W. Adams St., Chicago 3, Ill.


Machine Adzed Ties Carry America's Railway Traffic
The list of railroads using Nordberg Adzing Machines could serve as a directory of America's leading roads. Machine adzing of ties is universally recognized by mainten- ance men as an essential in the attainment of better quality of track work secured with less man hours and at the lowest possible cost.

FLEX-TOE Will Pull Spikes Like These Out of Your Track . . .

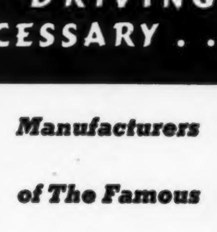
- MOVABLE TOES GRAB SPIKES
- HOLD TIGHTLY
- NO DRIVING NECESSARY . .

Faster and Safer Way To Pull Spikes

SEE those spikes above? They were actually pulled with a Flex-Toe Claw Bar by ONE MAN without a helper. This new bar not only removes brine-eaten and headless spikes or bolts, but also the ordinary kind faster and safer. **There's nothing new to learn.** Flex-Toe is thrown onto spikes in the usual way. Movable toes grab hold of any piece of protruding metal. **There's nothing to adjust.** As the handle is pulled, the toes take tighter hold and the spikes or bolts come out. **No driving is necessary.** These features were developed in the Flex-Toe Bar to speed spike pulling operations, provide a means of pulling spikes of ALL kinds, and to materially increase safety. Flex-Toe is receiving favorable and wide general acceptance. And remember, your claw bar costs will go down plenty when you use Flex-Toes.

You Only Need To Replace The Toes

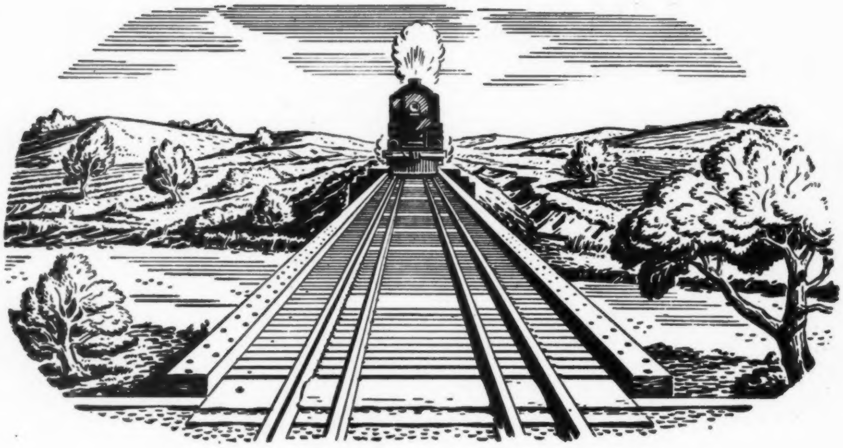
Manufacturers of The Famous Devil Line of Track Tools



WARREN TOOL CORP.
WARREN, OHIO

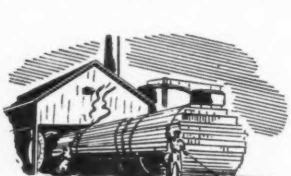
FORWARD THINKING RAILROAD MEN . .

build bridges resistant to fire and decay



Bridges and trestles built of Wolmanized* lumber last longer, with no added fire hazard. The Wolman Salts* preservative, driven deep into the wood, resists decay . . . will not corrode bolts, drift pins, spikes or timber connectors. Shop and freight-house timbers treated with Minalith* fire-retardant are flameproof. These treatments guard against the constant threat of premature destruction.

Pressure Treatment assures thorough protection



Pressure treatment under exacting laboratory control drives these protectives deep into the wood. Hundreds of millions of feet of lumber so treated are in service all over the world.

AMERICAN LUMBER & TREATING COMPANY

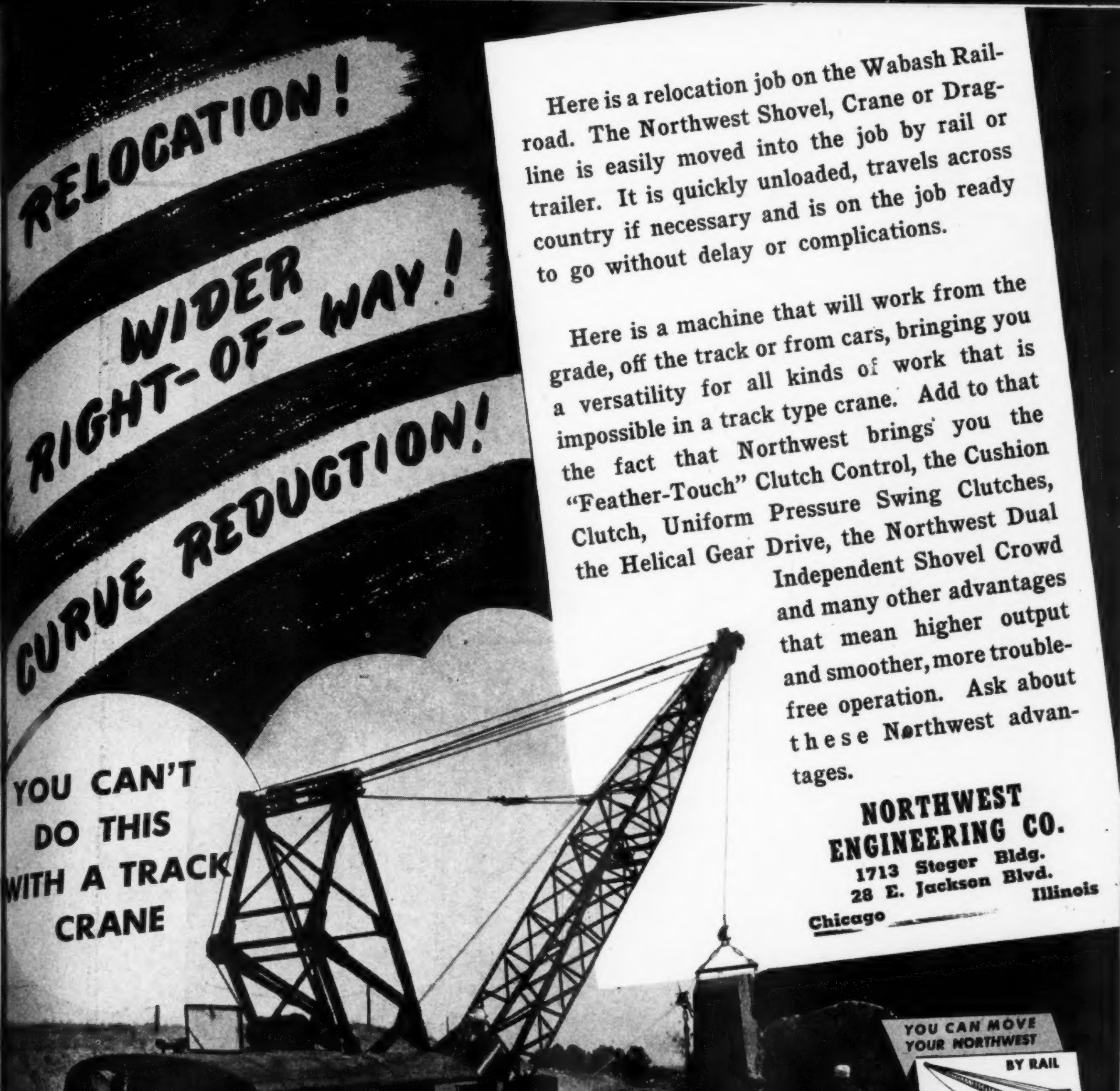
CREOSOTING

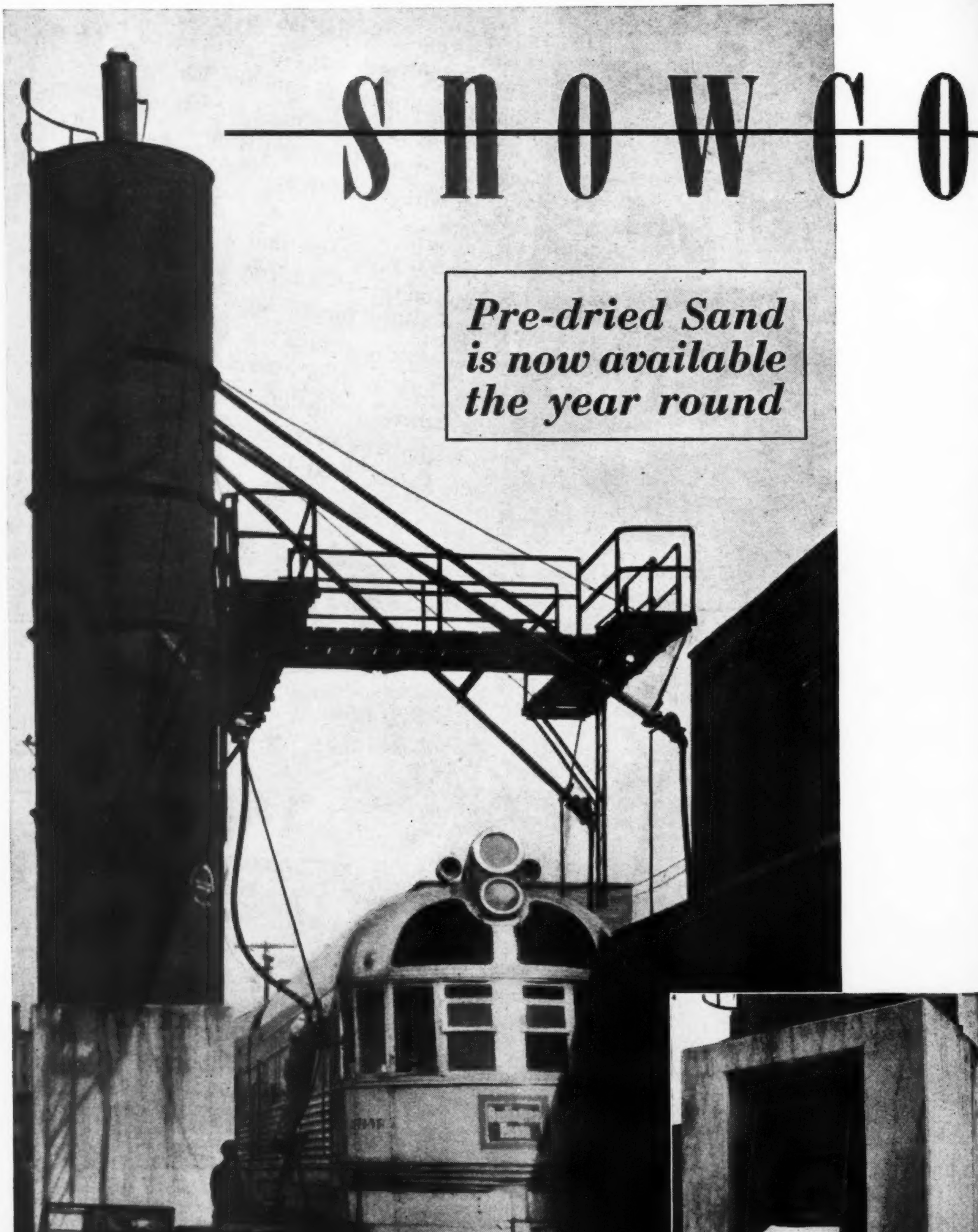
FLAMEPROOFING

WOLMANIZING

*Registered trademarks

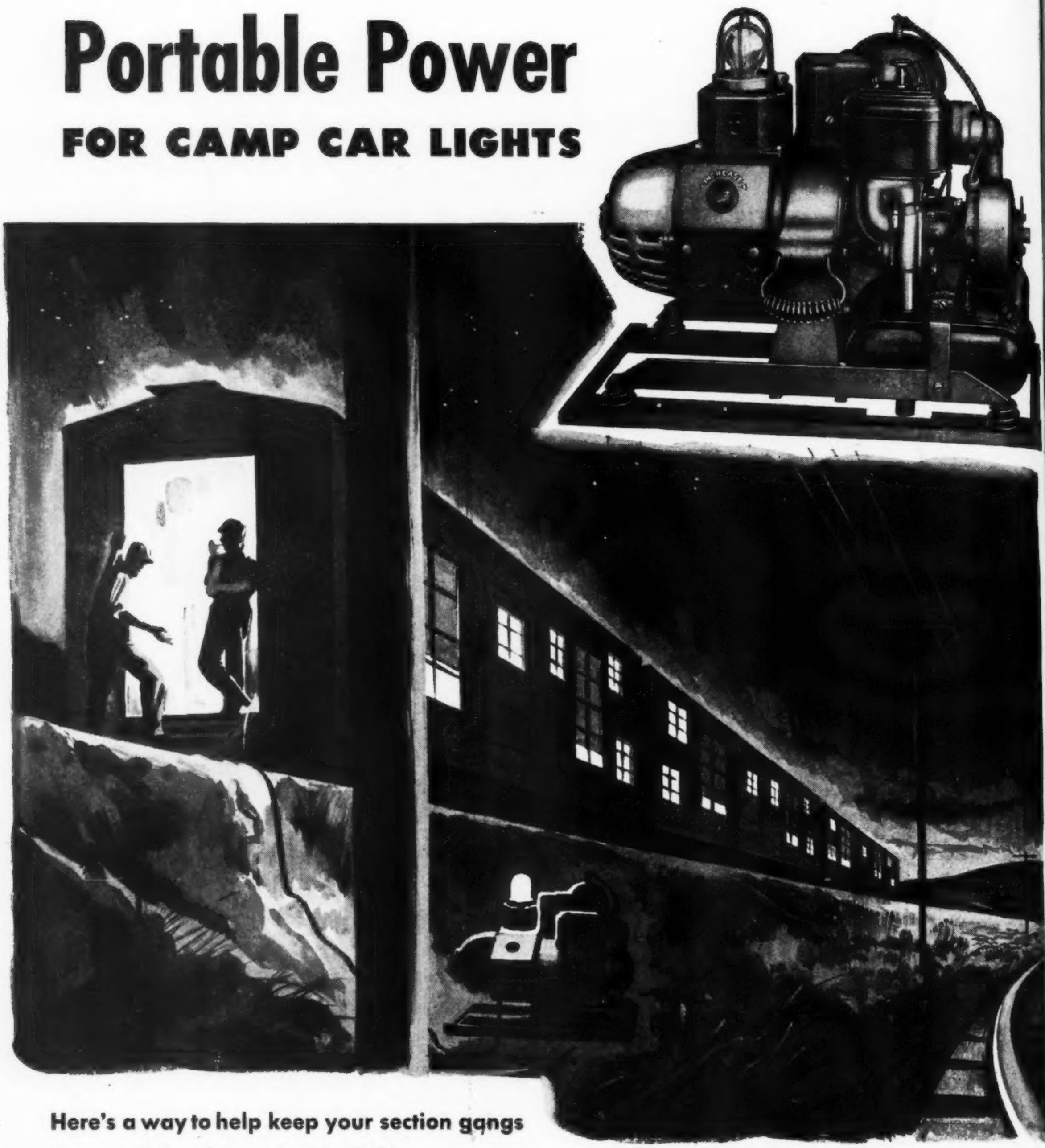
1659 McCORMICK BUILDING, CHICAGO 4, ILLINOIS


RELOCATION!
WIDER RIGHT-OF-WAY!
CURVE REDUCTION!
Here is a relocation job on the Wabash Railroad. The Northwest Shovel, Crane or Dragline is easily moved into the job by rail or trailer. It is quickly unloaded, travels across country if necessary and is on the job ready to go without delay or complications.
Here is a machine that will work from the grade, off the track or from cars, bringing you a versatility for all kinds of work that is impossible in a track type crane. Add to that the fact that Northwest brings you the "Feather-Touch" Clutch Control, the Cushion Clutch, Uniform Pressure Swing Clutches, the Helical Gear Drive, the Northwest Dual Independent Shovel Crowd and many other advantages that mean higher output and smoother, more trouble-free operation. Ask about these Northwest advantages.
NORTHWEST ENGINEERING CO.
1713 Steger Bldg.
28 E. Jackson Blvd.
Chicago Illinois
YOU CAN'T DO THIS WITH A TRACK CRANE
YOU CAN MOVE YOUR NORTHWEST
BY RAIL
ON ITS OWN TRAILER
OR YOU CAN BUY IT TRUCK-MOUNTED
NORTHWEST
THE ALL PURPOSE RAILROAD MACHINE
SHOVEL • CRANE • DRAGLINE • PULLSHOVEL
PROVED on the nation's LEADING RAILROADS


SNOWCO
Pre-dried Sand
is now available
the year round

Portable Power

FOR CAMP CAR LIGHTS



Here's a way to help keep your section gangs happy. Give them electric lights or power to operate their radios at night. All you have to do is start up a Homelite Gasoline-Engine-Driven Generator and, instantly your camp car has all the electricity it needs.

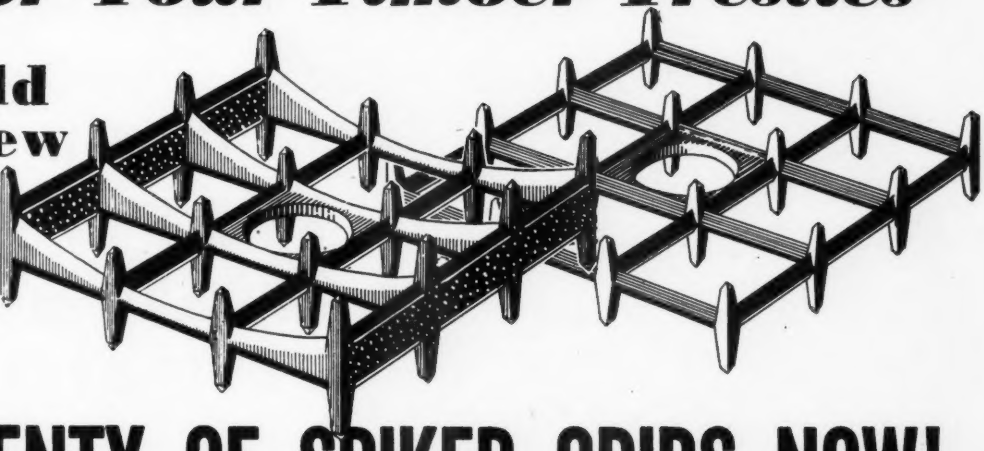
There are so many ways of using Homelite Portable Generators on railroad work that it would certainly pay you to have a Homelite man come out and give you a free demonstration. Simply write to us now, and we'll have your nearest Homelite representative call you soon.

Homelite Corporation

Portable PUMPS · GENERATORS · BLOWERS
PORT CHESTER, NEW YORK

For Your Timber Trestles

. . . old or new



PLENTY OF SPIKED GRIDS NOW!

TECO spiked grids, both curved and flat, for bracing joints of bridges, trestles and wharves are now available for immediate shipment.

You can now specify TECO Grids in your standard plans and be assured of quick delivery. Installed at critical points in a trestle, the Grids will give the structure a marked increase in rigidity even with today's heavier and faster-moving rail traffic.

During the War years when maintenance was curtailed and the use of materials restricted, some railway trestles were repaired by merely reinforcing the joints with spiked grids which effectively increased the rigidity of old structures. Ineffective bolt bracing with enlarged holes was corrected by the installation of Grids because the snug-fitting connectors transferred the load from one member to another distributing the stress over a much larger cross-section of the wood.

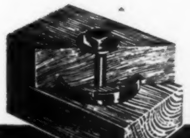
Specify TECO SPIKED GRIDS for your trestle bracing.

Watch for Announcement of New Booklet "Timber Connectors for Timber Construction in Railroad Service."

The Engineering Departments of Fifteen Class 1 Railroads have already used TECO SPIKED GRIDS for trestle bracing.

They are now specified in the standard plans for timber structures by many leading Roads. The recommended trestle designs of the A.R.E.A. show the grid as a typical connecting device for properly framed trestles.

The section below showing the use of the grids in bracing is from a recommended design of the A.R.E.A.



Timber Engineering Co., Inc. of Washington, D. C.

Washington • Chicago • New Orleans • San Francisco

SPECIFY TECO CONNECTORS • SPLIT RINGS • SHEAR PLATES • GROOVING TOOLS


FAST, HANDY, EFFICIENT—
THE NEW
BARCO
TYTAMPER
The rugged new Barco has a built-in ignition system which eliminates auxiliary attachments on the ground. That's why the Barco is easier to handle in congested traffic, crowded gangs — whenever rail tamping has to be done quickly, economically. Light, powerful, self-contained, Barco Tytampers always mean more work done in less time at lower cost, winter or summer. Write for detailed information on these famous tools.
BARCO
UNIT TYTAMPERS
THE FREE ENTERPRISE SYSTEM IS THE SALVATION OF AMERICAN BUSINESS

For many years Flintkote Protective Coatings have helped railroads defeat the twin enemies of their structures . . . abrasion and *corrosion.*

These asphalt compounds "plate" steel and concrete with a tough, long-wearing armor—highly resistant to flying cinders, moisture and fumes . . . add "extra years" of life to everything they protect.

On bridges, towers, walls . . . in roundhouses, train sheds, tunnels . . . and on gondolas, box cars, tank cars . . . Flintkote Protective Coatings and Car Cements are quickly, easily applied with spray or brush.

For over 40 years The Flintkote Company has served the railroads of the country with highest-quality Asphalt Protective Coatings, Adhesives, Car Cements, Mastic Floorings, Stock Car Floorings, Insulation Coatings and Building Materials . . .

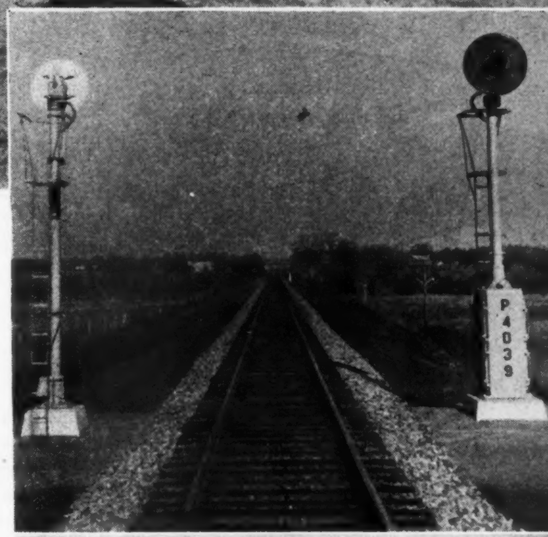
Let our Railway Department explain how these materials can lower *your* annual costs. Write for full information.

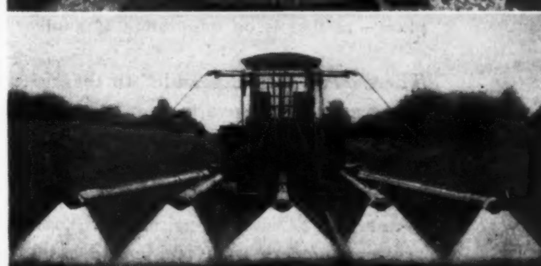
FLINTKOTE
INDUSTRIAL PRODUCTS

THE FLINTKOTE COMPANY • ***Industrial Products Div.*** • **30 Rockefeller Plaza, New York 20, N. Y.**

ATLANTA · BOSTON · CHICAGO HEIGHTS · DETROIT · LOS ANGELES · NEW ORLEANS · WASHINGTON · TORONTO · MONTREAL

Essential!





A SOLID WALL OF FLAME 25 FEET WIDE

Yes, *"Essential"* is an apt description of clean, weed-free track in its relation to modern, high-speed trains such as the Central of Georgia's Flamingo, pictured above, Dixie Flyer, City of Miami, Southland, Seminole Limited and Dixie Limited. The Central of Georgia uses 16 WOOLERY WEED BURNERS to keep roadbeds free of vegetation the economical way. Typical of their success in maintaining clean, weed-free track is the section of roadway illustrated at the right on the Birmingham-Columbus Division.

Because weed-free track is essential, more than 75 railroads are now using WOOLERY WEED BURNERS to assist them in keeping track maintenance on a paf with demand.

WOOLERY WEED BURNERS

Available in 5-burner, 3-burner, 2-burner and 1-burner models

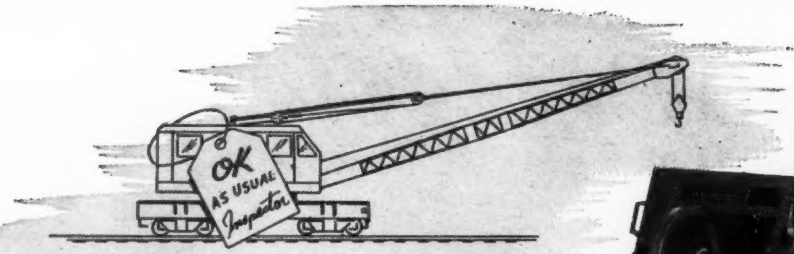
WOOLERY MACHINE COMPANY

MINNEAPOLIS Pioneer Manufacturers of **MINNESOTA**

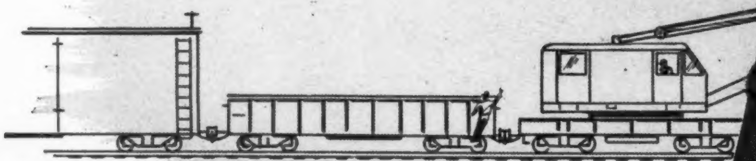
RAILWAY MAINTENANCE EQUIPMENT

RAILWAY WEED BURNERS • MOTOR CARS • TIE CUTTERS • TIE SCORING MACHINES • RAIL JOINT OILERS • CREOSOTE SPRAYERS • BOLT TIGHTENERS

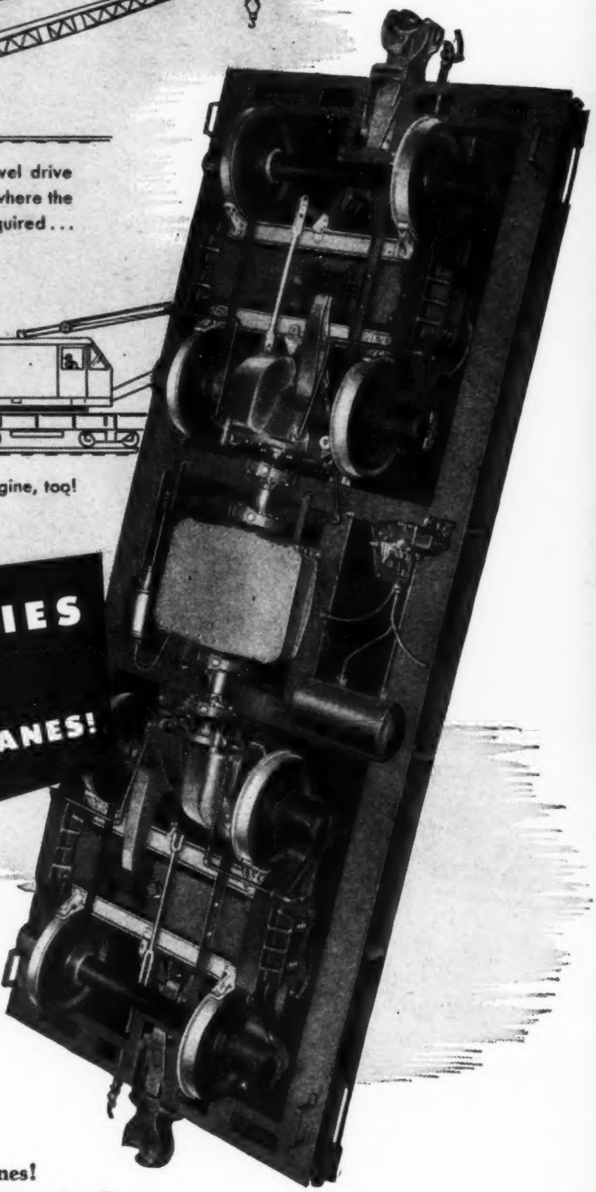
EXCLUSIVE EXPORT REPRESENTATIVES: PRESSED STEEL CAR COMPANY, INC., PITTSBURGH, PENNA.



"American" construction of trucks and travel drive mechanisms greatly reduces maintenance where the bulk of locomotive crane maintenance is required . . .



. . . makes a better private switching engine, too!



COMPARE CAR BODIES
and you'll choose
"AMERICAN" LOCOMOTIVE CRANES!

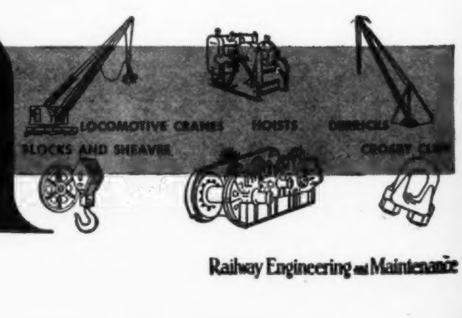
"American" is the one manufacturer that specializes in whichever type of locomotive crane you want: Diesel, Diesel-electric, gasoline or steam. Each "American" type is INDIVIDUALLY DESIGNED FROM THE TRUCKS UP to fit its particular power plant — neither is an adaptation of another!

There's no "soft underside" to these powerful cranes! For reasons that are apparent here, "American" Locomotive Cranes travel easier, pull more cars, make sharper turns and stay out of repair shops for longer periods. Have an engineer discuss all "American" car body construction features with you in detail. And remember, "American" Diesel-electrics, which have an electric motor in each truck, are even more maneuverable and easily operated than the type illustrated.

AMERICAN
HOIST & DERRICK CO.

St. Paul 1, Minnesota

CHICAGO · SAN FRANCISCO · NEW YORK



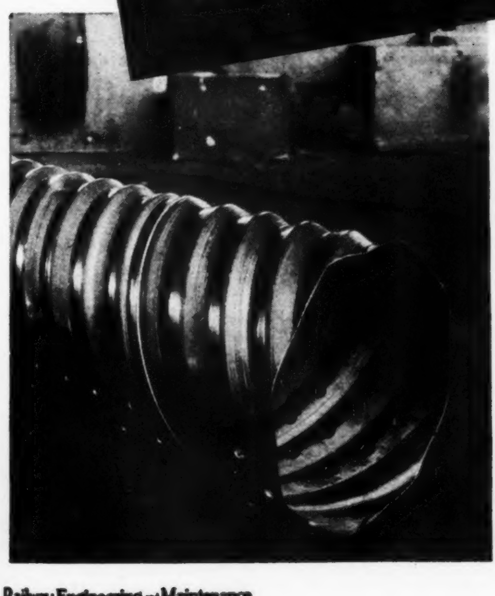
Get rid of COSTLY WATER POCKETS THIS EASY, SURE WAY

Standard ARMCO Perforated Corrugated Pipe was used to drain water pockets in the subgrade along this Midwestern railroad. Bottom view shows a section of helically corrugated (Hel-Cor) Perforated Pipe also used for subdrainage.

When water pockets in your roadbeds cut deeply into maintenance budgets, it's wise to put ARMCO Perforated Pipe on the job.

The use of this sturdy perforated pipe for drainage of pockets assures a stabilized subgrade and permits normal maintenance of the track.

Naturally your best insurance is to install this durable galvanized pipe when the roadbed is constructed. But if water pockets have formed in your present roadbeds, proper use of ARMCO Perforated Pipe will give you quick, efficient drainage.



CARRIES HEAVY LOADS, HIGH SPEEDS

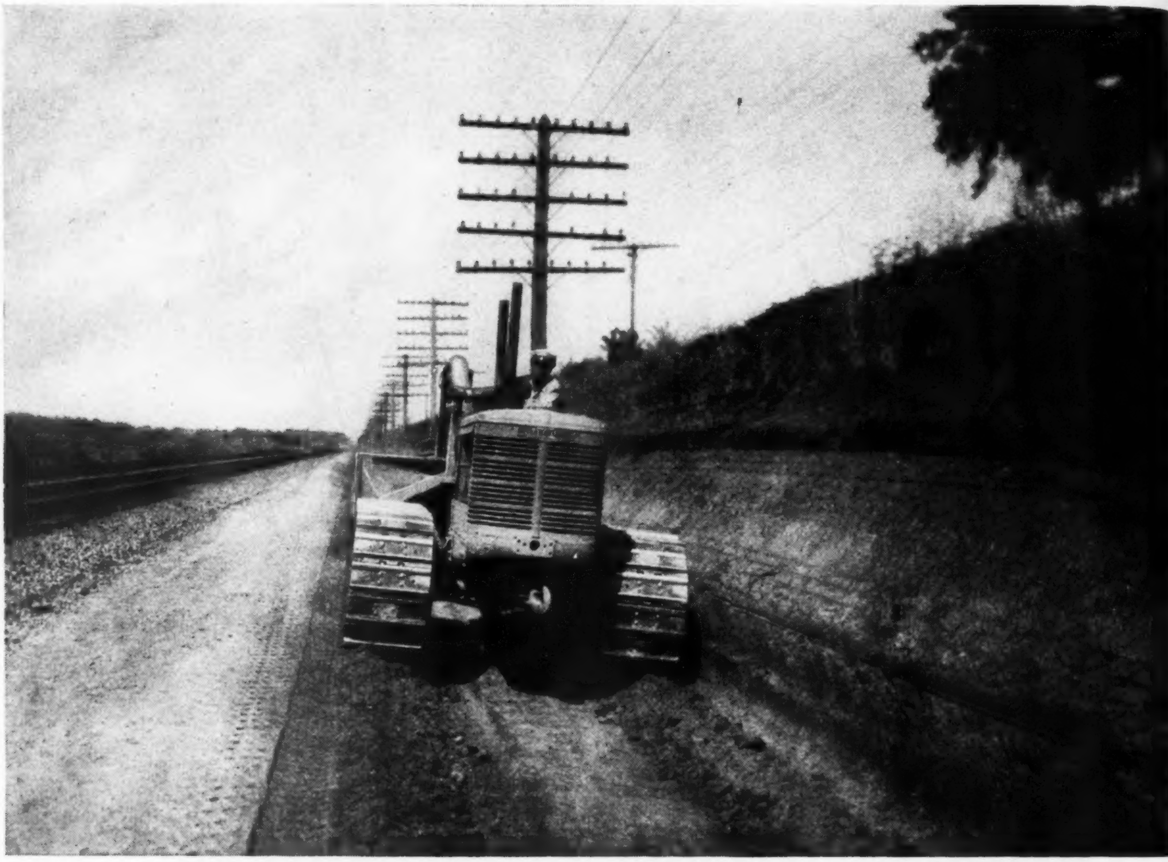
The flexible, corrugated metal design and strong joints resist crushing and disjointing. Heavy loads, high speeds, and severe frost heaving will not affect the system.

An Armco engineer will gladly give you complete information about ARMCO Perforated Pipe. Write your nearest Armco Drainage & Metal Products, Inc., Office or the executive offices of the company, 2911 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO DRAINAGE & METAL PRODUCTS, INC.

Modern Railway Maintenance



with INTERNATIONAL POWER

International Crawler Tractors and Industrial Power Units—mobile and stationary power plants—are furnishing the power for many railway construction and maintenance jobs today.

This is power that's *off the track*—out of the path of normal traffic—permitting an uninterrupted flow of trains while maintenance or construction is in progress.

International Power means durable and dependable power. Internationals stand up and slug it out with the job under the worst conditions. They're always ready to go at a moment's notice and keep going until the job is done. And they're economical to operate because they're engineered to deliver power at the lowest cost with a bare minimum of maintenance.

The International Industrial Power distributor has the full story about profitable applications of rugged, efficient International Power for railway construction work.

• Industrial Power Division •

INTERNATIONAL HARVESTER COMPANY

180 North Michigan Avenue Chicago 1, Illinois

INTERNATIONAL Industrial Power

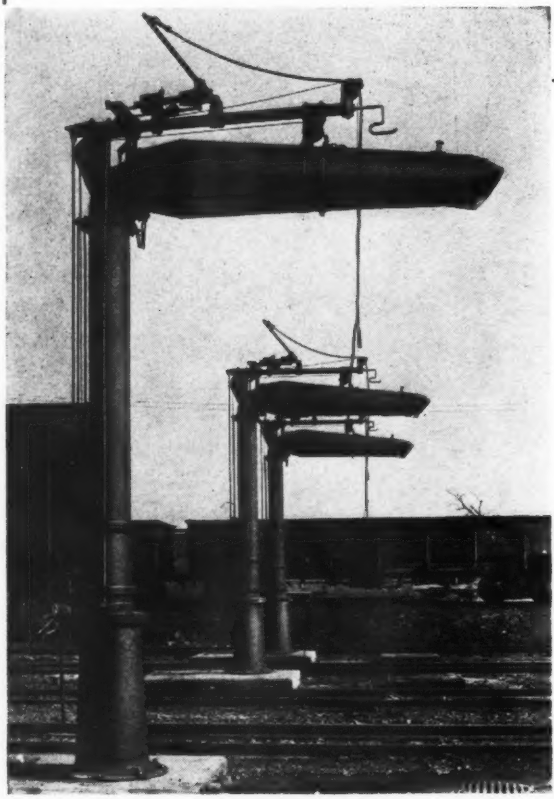
Thor AIR TOOLS...

SPEE

Removing excess metal from welded joints is done quickly and smoothly with Thor Chipping Hammers.

Angle Cutting wood girders with a 12" diameter blade Thor Portable Pneumatic Saw.

"WE SERVICE RAILROADS"



American railroads, maintaining fast schedules, at high speeds, must have dependable water service.

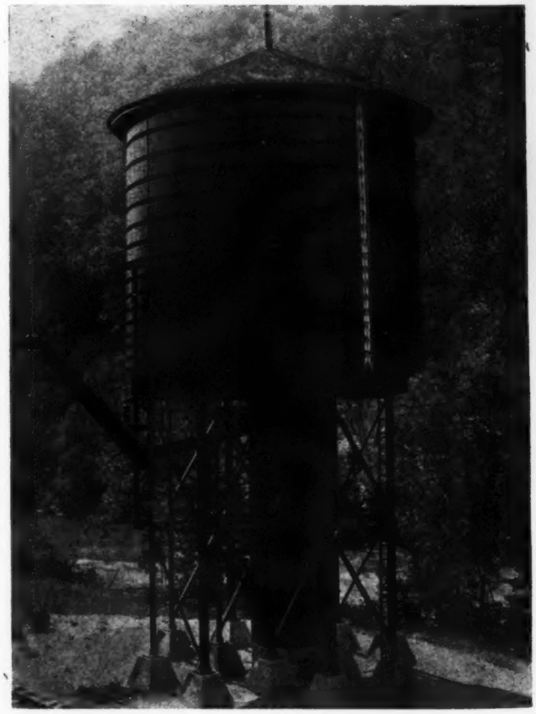
That's where we came in—over 90 years ago—to furnish highly efficient water tanks and columns to meet diversified requirements.

Superior workmanship plus a desire to build the best—has placed

U.S.-CHALLENGE PRODUCTS

along thousands of miles of rights-of-way, and we are prepared to continue furnishing this quality equipment to meet present and future demands.

Mansfield Type "B" Water Columns
Mansfield Water Columns
U. S. Hydraulic Valve Water Columns
Halladay Tank Fixtures
Halladay Outlet Valves
Pump Jacks
Float Valves **Curtis Pumps**
Wood Water Tanks
Water Handling Appliances
Tank Stuffing Boxes
General Water Supplies
Switch Stands **Semaphores**



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COMPANY
2000 Wilson St., Batavia, Ill.
Division of Batavia Metal Products, Inc.

To prevent wear between rails and joint bar use—

Hubbard SUPER SERVICE Alloy Spring Washers

The high-reactive quality of these washers makes it possible for them to withstand bolt tensions up to 30,000 lbs.

New York Office	HUBBARD and COMPANY	Chicago Office
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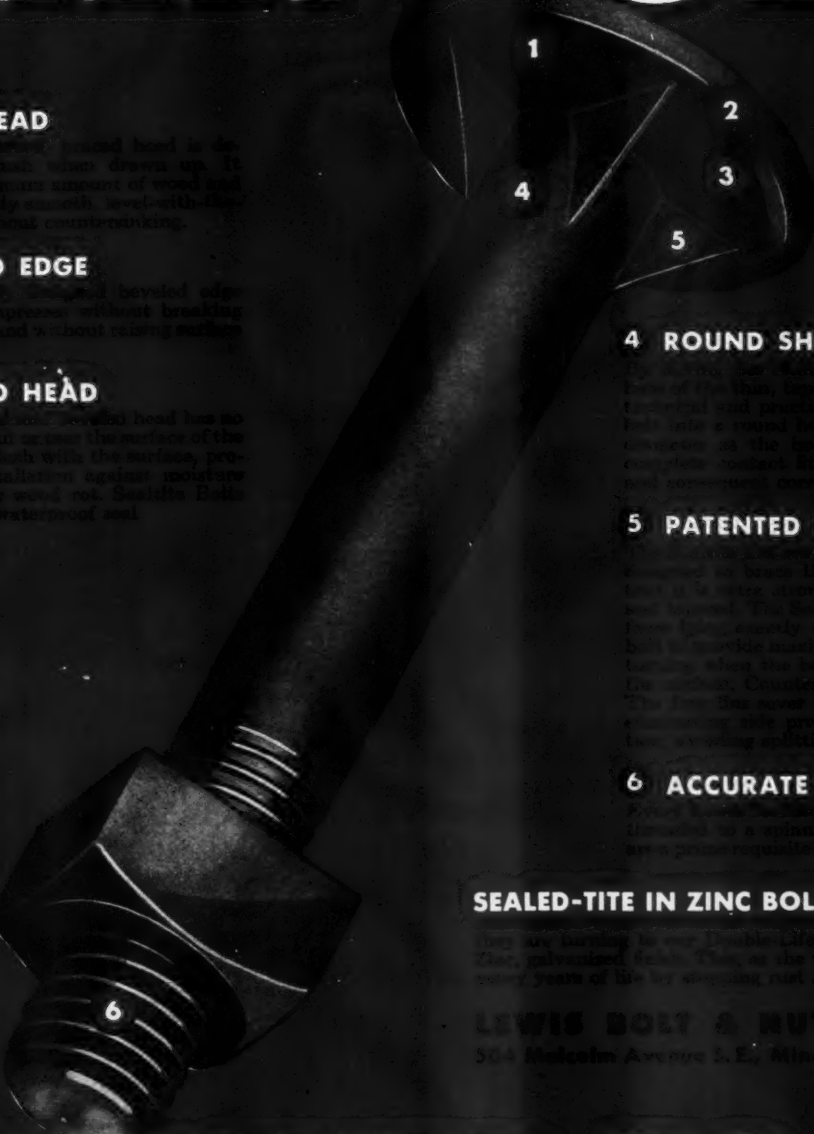
SEALTITE CAR BOLT



1 THIN HEAD

2 BEVELED EDGE

3 TAPERED HEAD

4 ROUND SHANK

5 PATENTED FINS

6 ACCURATE THREADING

SEALED-TITE IN ZINC BOLTS ... Although many

LEWIS BOLT & NUT COMPANY

504 Malcolm Avenue S. E., Minneapolis, Minnesota

DESIGNED TO DO A BETTER JOB

Run on Track Maintained with JACKSON VIBRATORY Tampers

Could anything be more indicative of the superiority of JACKSON Vibratory Tampers than the fact that they are used almost exclusively by 4 out of 5 of America's leading Railroads?

Never in the history of railroading was there a greater demand for maintenance equipment that will do the job quicker, better and easier. And you'll find, if you haven't already done so, that JACKSON Vibratory Tampers and Power Plants do exactly that, in all types of ballast, in all lifts, under all conditions to which tampers can be put. Complete information on dependable JACKSON Tampers and Power Plants and the best way to use them will be sent promptly on request.

ELECTRIC TAMPER & EQUIPMENT CO., Ludington, Michigan

NEW MODEL

McWilliams "MOLE"
Ballast Cleaner

The new model "MOLE" Ballast Cleaner has been designed to do the same thorough ballast cleaning job as the original "Mole." Refinements and improvements, however, enable the new model "MOLE" to do this job faster and more economically.

Clean ballast is of greater importance now than ever before, and the new model "MOLE" will do the best possible job for you at the least cost.

WRITE US TODAY FOR COMPLETE INFORMATION AND SPECIFICATIONS

RAILWAY MAINTENANCE CORP.
Pittsburgh 30, Pa.

The "MOLE" is available in border and intertrack models

No. 203 of a Series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO 3, ILL.

Subject: Let's Finish the Job

November 1, 1945

Dear Readers:

For the forty-seven months since "Pearl Harbor", the American people have been patriotically pouring their earnings into Defense and War Bonds to support the huge expenditures of the country's war effort. Railway employees—and there is no more patriotic and responsive group of employees in America—have established an outstanding record of bond purchases from the start and, among them, you in the maintenance of way and structures departments of many roads have stood at the top of the list.

Through your support of previous bond drives, you, supplementing your loyal adherence to your vital transportation jobs, helped bring quick and decisive victory over Germany and Japan. Now comes the final test—The Victory Loan Drive—a drive to raise the billions of dollars necessary to bring our fighting men back home; to care for the wounded; to re-establish tens of thousands in peace-time pursuits; to maintain our armies of occupation; to help check inflation—to finish the job.

Patriotism alone demands full support of this loan, and will be the principal motivating influence in putting it over, but at the same time one can have the confidence that the bonds involved can be purchased on their merits, wholly aside from all considerations of patriotism. What will be your record in this drive?

Railway Engineering and Maintenance, in both its editorial and advertising pages, separately and jointly with advertisers, has given generously of its space to support every national bond drive, and in this issue, in this letter to you, and on page 1186, contributed to the United States Treasury Department, we urge you anew to Match Their BEST with Your MOST in the Victory Loan Drive now under way.

"They finished their job—let's finish ours!" And may we add—"keep your bonds."

Sincerely,

Neal D. Howard

Editor

NDH:jb

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

NOVEMBER, 1945

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PRINTED IN U.S.A.

Railway Engineering and Maintenance

Conventions—

Roadmaster and B. & B. Groups Plan Experiment

Practically all of the readers of this publication, because of the nature of their responsibilities, are interested in the activities of the Roadmasters' and Bridge and Building associations. Therefore, it seems as natural to comment on these associations here as it would be to refer to any phase of track or bridge and building work. And comment is in order—first, to congratulate both associations for the steadfastness with which they, in spite of serious handicaps, carried on their investigations and other essential work throughout the war period, and second, to wish them unlimited success as they strike out to recoup their war losses in membership and undertake aggressively the work of the year ahead.

Both associations have put up a valiant fight during the last three years. Denied their regular annual conventions and the usual accompanying exhibits by the Track Supply and the Bridge and Building Supply Men's Associations, they have, nevertheless, prepared and issued some of the most constructive reports in their long history, now extending over fifty years. Those of the Roadmasters for the last year, presented at a restricted one-day meeting on September 12, were published in full in the October issue of this publication; those of the Bridge and Building association for the last year, presented at a similarly restricted meeting in Chicago on October 17, are published in full in this issue, in a special section, together with a running report of the other activities at this meeting. With the presentation of these reports, another year's work was done. Now, both associations look aggressively to the year ahead, each with a new group of timely subjects to study in the interest of improved practices, higher standards, greater efficiency and maximum safety.

One outstanding change from the usual custom will mark the climax of each association's year in 1946. The Bridge and Building Association has adopted a plan, with the consent and endorsement of the Roadmasters, which will advance the time of its annual meeting one month to a date concurrent with the annual meeting of the Roadmasters, set for September 17, 18 and 19. Both meetings will be held in the Hotel Stevens, Chicago, and, except for such joint sessions as may be arranged, will be in widely separated rooms on the same floor. Another feature of the plan contemplates a joint exhibit of track and bridge and building supply companies in the Exhibition Hall of the hotel, which, with war restrictions on materials and equipment lifted, promises to be the largest exhibit, with the greatest educational value, of any ever held in the history of either association.

With all of the principal hotels in Chicago already booked to capacity with conventions scheduled for the fall of next year, the foregoing plan was, necessarily, made in haste to insure any hotel accomodations at all, but it was not made without giving the most careful consideration to all of the factors involved, and not without the advice and counsel of many higher railway officers—all of whom were favorable to it.

It is an interesting experiment, but not without many possibilities. With the right spirit of co-operation between the two railroad associations, which is assured by many years of such co-operation; with the continued co-operation of the interested railway supply companies, which have always been eager to co-operate; and with the backing and support of higher engineering and maintenance officers to the end that their roads will be adequately represented at the meetings, the plan seems not only assured of success, but may well set a new high in the value of these associations to all concerned.

Winter-Laid Rail

Needs All the Care It Can Be Given

PRESENT indications point to the probability that more rail will be laid in 1946 than in any year since 1929. If these indications prove correct, the tonnage of new rail weighing more than 100 lb. will be greater than in any previous year, and will be of correspondingly higher value. If they prove correct, it is also quite likely that a considerable mileage of the new rail will be laid during the winter months.

How do the preparatory work, the laying of the rail, and the care of winter-laid rail differ from similar work done at other seasons? Whenever new rail is to be laid, the existing track should be in good surface and to good line. This is of much greater importance if the rail is to be laid when the track is frozen, when no surfacing can be done and loose ties cannot be tamped to give a uniform support to the rail, in order to insure against surface-bent rail. In other words, the preparatory work is fully as important as the attention that should be given the new rail after it is laid.

Suitable preparation does not require that the track be given a general raise unless this would have been necessary regardless of the rail program. In fact, in most cases, it is better not to do so, but rather to do such spot surfacing as will be necessary to insure a uniform support for the new rail, deferring the cleaning of the old ballast and the application of the new ballast until weather conditions permit the track to be given a general surfacing. However, any ties that are not capable of giving sufficient support to the new rail to prevent bending, should be renewed early enough to make certain that they are bedded solidly before frost enters the roadbed. If they are replaced too late, the track will be rough all winter and the new rail will not be given the uniform support it should have. It is of equal importance that the track be lined carefully so that it will enter the winter in good line and thus avoid the necessity for spike lining, either prior or subsequent to the laying of the new rail.

Careful preparation will reduce materially the amount of attention that will be demanded by winter-laid rail. It should not be assumed, however, that it will eliminate all necessity for giving it special care. No matter how careful the preparation, some defects in surface will occur. While there will be no swinging ties, some irregularities of surface will inevitably creep in, primarily as a result of adzing, and these must be cared for by the application of shims. If other irregularities occur, the same remedy must be applied. If the track was in good line and the rail was laid carefully, there is so little likelihood that the line will give trouble as to be practically negligible, unless the track heaves, in which event the remedy for the trouble is the same as it would be in any case of heaving.

The opportunities for irreparable damage to winter-laid rail are constantly present during both the laying operation and subsequently until it has been surfaced, but the means for avoiding this damage are so easy of application, that there can be no excuse for allowing it to occur. This is especially true at the present time, when the railways are so badly in need of rail. A surface-bent rail remains a surface-bent rail to the end of its service life, and no *post facto* action will make it any different. No railway planning winter rail laying can afford to do otherwise than prepare the track carefully, lay the rail carefully, and then attend to it carefully until there has been an opportunity to surface it carefully.

Man-Power—

Shortage Still Acute in Maintenance Work

JUDGING by reports received from widely-separated parts of the country, the shortage of man-power in the maintenance of way departments of the railroads is as acute now, if not more so, than at any time since the war began. This is indeed an anomalous situation. Everywhere war plants that once absorbed thousands of workers are now vacant and deserted, their chimneys sending forth no smoke and their vast parking lots entirely denuded of the endless rows of workers' cars that formerly occupied them. Hampered as it is by confusion in government and by industrial strife, the reconversion of industry to peace-time pursuits has barely made a beginning. Meanwhile, from all corners of the globe the country's fighting men are streaming homeward, again to resume their civilian status and, with it, the need for jobs.

In view of these developments it would seem logical to expect that there would be at least some alleviation of the shortage of man-power in maintenance of way work. But nothing of the sort has occurred. Without endeavoring to explain the reasons for the phenomenon, the fact is that former war workers and discharged service men are showing practically no disposition to go to work on the track and only slightly more interest in bridge and building work.

An example of what the railroads are up against in this respect is afforded by the experience of an eastern road in endeavoring to recruit employees for track work through the agency of an employment booth in a passenger station. Over a period of time a total of 36 men were signed up for work by the personnel man in charge of the booth. Of these only 24 reached the office where they were to be assigned to their duties, this office being located on the third floor of a building adjacent to the station. By the time the men reached the track, ready for work, only 20 of them were left, and at the end of 10 days all but four of these had quit their jobs. During the period in which these events were occurring the railroad lost the services of eight other trackmen at the same point.

The ending of the war has not, generally speaking, brought with it any appreciable reduction in the demand for maintenance labor. With traffic remaining at a relatively high level, the current needs of the properties are still great and, furthermore, there is a large amount of deferred maintenance to be made up. Also, with many roads making plans to offer better and faster passenger

service, there is almost certain to be an increasing demand for higher standards of track maintenance.

Confronted with these needs—and at the same time a continuing shortage of man-power—maintenance officers are faced with a serious problem, which is not alleviated in any way by the government's action in requiring that all Mexican Nationals now working on the railroads be returned to their homeland by the end of February, 1946. The situation may change for the better over a period of time, but until it does the railroads have no alternative but to apply, in an intensified manner, all the lessons they learned during the war years in recruiting labor—and to be sure they are not overlooking any possibilities for mechanizing maintenance work.

Committee Work—

An Activity That Pays Dividends

THE MONTHS of September and October of another year have come and gone, and with them the annual meetings of the Roadmasters' and Maintenance of Way Association and the American Railway Bridge and Building Association. Regardless of whether the annual affairs of these associations are restricted to one day, as they were this year, or whether the programs are based on a three-day meeting, as in normal times, the one aspect common to all of their meetings is the fact that the reading and discussion of committee reports is the main activity.

This is as it should be. No better medium has been devised than the committee report as a means of investigating current problems and developments, of evaluating the various relevant factors in connection with them, of correlating the thinking that is being done regarding them by individuals in widely-separated parts of the country, and of bringing the findings to the attention of those most directly interested under conditions designed to promote debate and discussion. This is democracy at work as applied to a particular field of endeavor, and the ultimate over-all effect, when the idea is applied consistently and conscientiously year after year, is to accelerate and enhance technical progress.

Thus the technical committee report has become an institution that deserves the whole-hearted support of all those who are interested in promoting progress in their particular field of activity. There is no better way of manifesting this support than by participating actively in the work of preparing such reports—in being unstinting in contributing of one's own knowledge and experience to the end that others will benefit by them. To be of the greatest value to the field every committee report should embody a cross-section of views and experience, based on contributions from *all* the members—not just a few or even one (the chairman) as sometimes happens. In a sense, committee work is a "give-and-take" proposition; that is, a member "gives" by making a contribution of his own and "takes" by benefiting through the contributions of others. To the extent that a "let-George-do-it" attitude prevails, committee reports will fall short of serving their purpose.

Both the Roadmasters' and the Bridge and Building Associations have selected the subjects on which committee reports are to be prepared for presentation at their 1946 convention. Soon the members of both associations will be asked to volunteer for service in the preparation of these reports. Since the future of the railroad industry will depend to a large extent on the degree of success achieved in solving their technical problems, each member of the two associations can do his part in assuring that future—and his—by joining one of the committees and participating actively in the preparation of its report.

Dismantling Buildings—

New Practice Should Be Continued

AS far back as the memory of the oldest employee reaches, the dismantling of railway buildings has been a job to be done expeditiously, with little regard for salvage, except in the case of hardware, sash, plumbing fixtures, heating plants and equipment such as electric motors. In many cases, even valuable installations of pipe have been fit only for the scrap pile when the job was finished. The wrecking bar and sledge were the tools used most commonly, and the lumber removed from a frame building was usually fit only for a bonfire. In some cases, so little value was placed on the recoverable material that outside parties were permitted to remove structures without cost, or for a very nominal sum, provided they would smooth up the site of the structure and leave it in a presentable condition. In others, contractors were paid for dismantling buildings and were also allowed to keep the salvage.

The material shortages that occurred as a result of the war made it imperative that every item that could be recovered be removed carefully and re-used. Not only was it difficult to obtain permission to use new materials, but the demand for them for military uses exceeded current production in many instances. This was especially true of timbers and lumber, so that railway stocks and those of commercial lumber yards were depleted.

It is going to require a long time to build these stocks back to normal. In the meantime the railways are faced with the necessity for a much greater than normal building program, which they must undertake with vigor if they expect to retain their present pre-eminence in the transportation field. They cannot expect to go on indefinitely trailing prospective passengers through outmoded stations to reach luxurious streamliners, or to continue to turn them out at destination into the drab surroundings that characterize many of their passenger stations. Competitors are aware of the psychological effect of such surroundings and are providing light, attractive and clean stations for the accommodation of their patrons.

Since the railways must do likewise, besides modernizing a multitude of other buildings to meet today's requirements, and since they may expect to experience more or less difficulty in obtaining some of the materials they will need to carry out such work, the practice of recovering all of the usable materials possible when dismantling structures, started as a war-time necessity, should be continued with persistence. This will not only save much money that would otherwise be wasted, but it may make considerable difference in the ability of the railways to complete their programs.

The principles involved in moving earth by mechanized methods have now been applied to the skeletonizing of track on the Pere Marquette. With crawler tractors as the prime movers, the new system involves the use of three new devices specially designed for cribbing work, including a rooter for loosening the ballast, a drag bucket for removing it, and a scraper shovel for cleaning it from the ends of the cribs. Although it is not yet entirely out of the experimental stage the method has already demonstrated its ability to produce substantial economies as compared with hand methods, and also has other important advantages.

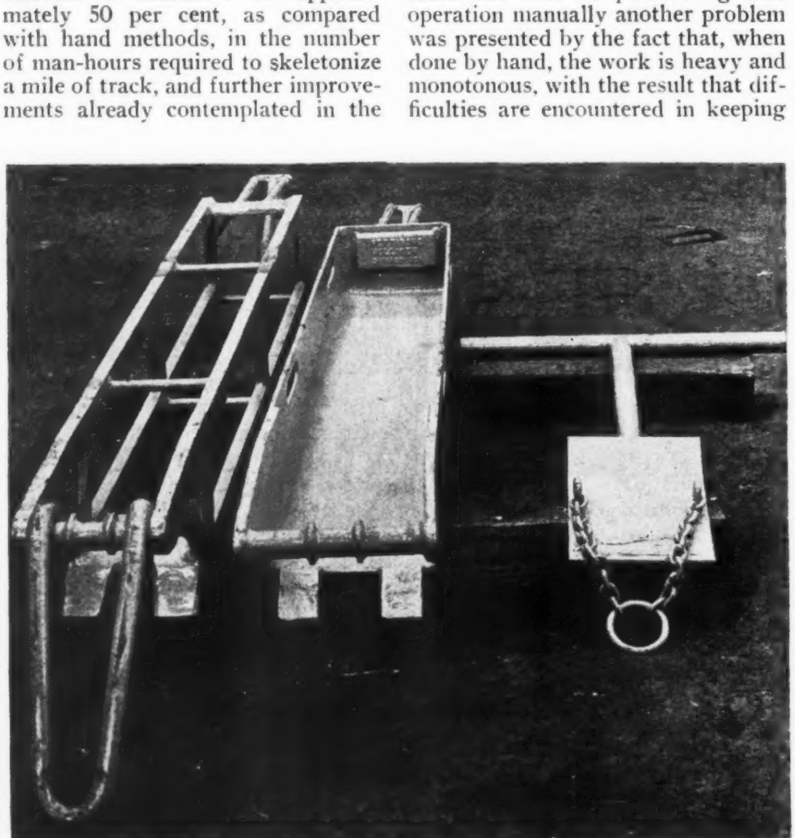
This New Cribbing

SOMETHING entirely new in the way of equipment and methods for skeletonizing track in preparation for reballasting work has been developed on the Pere Marquette and was first used with highly satisfactory results during the last summer. Although this development is still in the experimental stage in some respects, the results obtained to date indicate a reduction of approximately 50 per cent, as compared with hand methods, in the number of man-hours required to skeletonize a mile of track, and further improvements already contemplated in the equipment and organization used are expected to result in even greater economies. Aside from the large savings obtained by the new system, its superiority over hand methods is further enhanced by other important advantages which will be discussed later in this article.

Hand Work Costly

Reballasting on the Pere Marquette consists of removing the existing ballast to the bottoms of the ties, which are 8½ ft. long, and then raising the track on new crushed stone ballast. Carrying out this work by hand methods has been a tedious and costly operation, particularly where the old ballast, usually consisting of gravel, has become fouled. Aside from the cost of performing this operation manually another problem was presented by the fact that, when done by hand, the work is heavy and monotonous, with the result that difficulties are encountered in keeping men on the job. It was these considerations that led to a search for better and more efficient ways of doing the work, which search has now resulted in the development of the devices and methods described in this article.

Basically, the system used is an adaptation of modern methods of moving earth with mechanized equipment. In its essential aspects the method involves the use of crawler tractors as power units in connection with a number of new devices especially designed and built for the task of loosening and removing ballast from between the ties. The two principal units that have been developed for this work are a rooter and a drag bucket. The first is an elongated skeleton-like framework of steel members, with cutting teeth on the front end, which is drawn through each crib to loosen the ballast preliminary to removing it with the bucket. The latter unit is an elongated drag-line type bucket, likewise with cutting teeth, which is capable of removing nearly all of the ballast in a tie crib by being drawn through it once. The rooter and the bucket are each pulled through the cribs from one side of the track to the other by a cable threaded under the rails and winding on a winch mounted on a crawler tractor. Another device that has been developed for use in the cribbing operation is a scraper-type shovel, designed also to be pulled by a tractor winch, the purpose of which is to remove the ballast from between the ends of the ties outside the rails.



This View Shows (Left to Right) the Rooter, the Bucket and the Drag Shovel

The New Procedure

Using the equipment described above, the track is skeletonized in a sequence of operations involving seven principal steps as follows: (1) Removal of the shoulder ballast from the ends of the ties with a small crawler tractor mounting an angle dozer; (2) preliminary loosening of the old ballast in the cribs with pneumatic cribbing forks; (3) removal of the ballast from between the ties outside the rails, using the special scraper shovels; (4) the shifting of the

Method Brings Large Savings on Pere Marquette

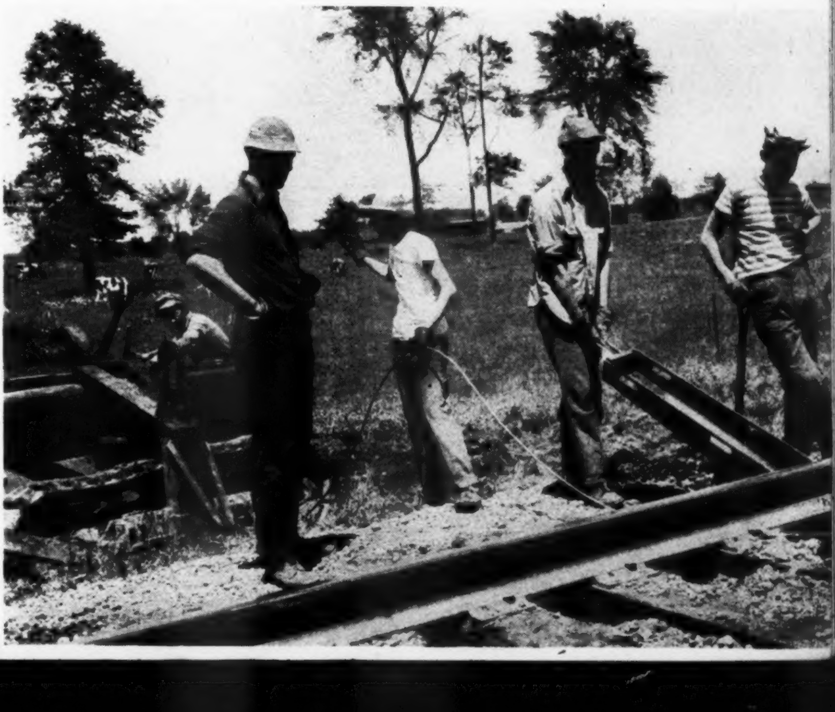
ballast removed in the third operation to the roadbed shoulder with the angle dozer or by hand; (5) the loosening of the ballast in the cribs by pulling the rooter through each of them, an operation that removes about 25 per cent of the ballast; (6) removal of the remaining ballast in the cribs by drawing the bucket through each of them; and (7) the use of the angle dozer to smooth the berm and to shift the ballast removed from the cribs to the edge of the shoulder. The small amount of ballast left in the cribs after the bucket has passed through them is easily removed by hand shovel.

The foregoing procedure, using one rooter and one bucket, is carried out with a gang of 16 men, including the foreman. The average output attained by this organization during the past summer, when approximately 8½ miles of track were cribbed by the new method, was 120 track-feet per hour of actual working time. This represents a large increase in output per man as compared with hand methods; further, the increased output is obtained with the aid of devices that greatly reduce the drudgery and monotony that are associated with the work when it is performed by hand. It is reasoned that the resulting improvement in working conditions is certain to result in better morale among the men and in a smaller turnover in the personnel of the gang, these being considerations that are particularly important during a period when labor is scarce. On the Pere Marquette the skeletonizing work that has been done to date using the new equipment has been carried out by a gang consisting largely of high school boys, and it is reported that the results have been highly satisfactory from every point of view.

Off-Track Equipment

It should be noted that all the equipment used with the new system is of the off-track type, and that the operation involves no interference with traffic other than that occasioned when trains slow down to

Above—Directing the Rooter Into a Crib. Below—This View Shows the Bucket Being Started Through a Crib and Signals Being Given for Pulling the Rooter from the Opposite Direction



pass over the skeletonized track. When a train approaches the tractors pull over as necessary to clear it, and work is resumed as soon as the rear of the train has passed. It is reported moreover that there is no interference with track circuits.

Problems of Design

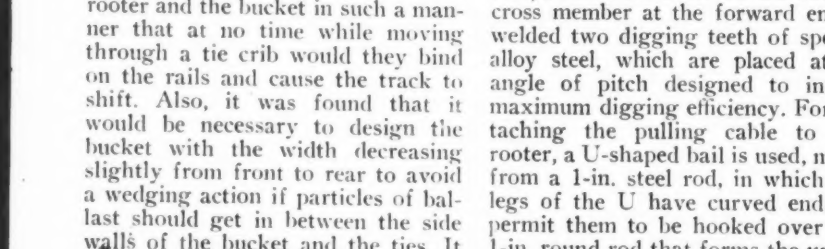
The idea of adapting mechanized earth-moving methods to track-cribbing work was conceived by R. A. Morrison, division engineer of the Detroit-Grand Rapids division of the Pere Marquette. In putting this idea into practice the most difficult problem encountered was that of designing and building a rooter and a bucket that would do the job in a satisfactory manner. While the development work was still in its early stages the Pettibone Mulliken Corporation, Chicago, became interested in the project and thereafter the experience and knowledge of this company in building earth-moving equipment was applied to the problem of designing a satisfactory rooter and bucket for the cribbing operation. Various types of devices were designed, tested and redesigned before the problems of obtaining the proper shape, dimensions and construction were worked out satisfactorily.

Among the problems encountered were those of designing both the rooter and the bucket in such a manner that at no time while moving through a tie crib would they bind on the rails and cause the track to shift. Also, it was found that it would be necessary to design the bucket with the width decreasing slightly from front to rear to avoid a wedging action if particles of ballast should get in between the side walls of the bucket and the ties. It was necessary, in addition, to determine the proper pitch for the cutting teeth for both the rooter and the bucket. There was also the problem of building and reinforcing the two devices in such a manner as to obtain the strength required, while at the same time not overlooking the necessity of making them as light as possible to facilitate handling.

The Rooter

In its present stage of development the rooter, as already noted is an elongated skeleton-like frame, which is constructed almost altogether of ¾-in. by 1½-in. bar stock, arc-welded at the joints. The principal members of the frame include a longitudinal piece at each corner and a number of vertical and transverse members in the planes of the sides and the top and bottom. The frame itself is 50 in. long, but the over-all length is increased to 72 in. by a 10. in. "nose" and a 12 in. "tail" the latter of which, by bearing against the rail on the entering side, prevents the rear end of the rooter from rising into the air as the device is starting to pass out of a crib. The tail also serves as a handle for use in guiding the rooter into the cribs.

The frame of the rooter is rectangular in cross section and is 7 in. wide throughout, but the depth tapers from 7½ in. at the forward end to 6½ in. at the rear. To the bottom cross member at the forward end is welded two digging teeth of special alloy steel, which are placed at an angle of pitch designed to insure maximum digging efficiency. For attaching the pulling cable to the rooter, a U-shaped bail is used, made from a 1-in. steel rod, in which the legs of the U have curved ends to permit them to be hooked over the 1-in. round rod that forms the upper cross member at the forward end of the rooter.



The Preliminary Loosening of the Ballast Is Done with the Aid of Pneumatic Cribbing Forks

With certain slight variations the shape and size of the bucket are approximately similar to those of the rooter. Its length is 72 in. overall, including a tail assembly at the rear end, and the height is 7½ in. at the front and 5 in. at the rear. The width of the bucket tapers from 9¼ in. at the forward end to 8 in. at the rear, the purpose of the taper being, as already indicated, to prevent a wedging action when particles of ballast gain access to the spaces between the side walls of the bucket and the ties. The bottom, the two sides and the rear end of the bucket are made of ¼-in. high-tensile, abrasion-resisting steel plate, fabricated by welding. For convenience in handling the bucket two slotted hand holes are provided in each side wall. At the forward end, as in the rooter, there are two digging teeth welded to the cutting edge, and a round cross bar for engaging the bail.

The Scraper Shovel

The scraper shovel by means of which the ends of the cribs are cleared of ballast, is similar in shape to the old fashioned square-nosed spade. It consists of a T-shaped tubular handle welded to a blade 7 in. wide and 13 in. long, consisting of a piece of high-tensile abrasion-resisting steel plate. The overall length of the shovel is 35 in. Fastened to the blade, in a position to insure the proper balance when pull is exerted, is a chain bridle containing a steel ring to which the pulling cable can be attached.

To use the crib-end shovel the operator heads it into the ballast outside of the rail and holds the handle so that it slants slightly outward at the bottom while the shovel is pulled out of the crib by the tractor winch. A movement of about 18 in. is all that is necessary, after which the shovel is transferred to the next crib and the operation repeated. The efficiency of this operation may be increased by using several shovels in a "gang" arrangement with one tractor winch, as many as three of them having been handled successfully in this manner. The experience has been that this work should be carried forward on both sides of the track simultaneously, using two tractors.

When skeletonizing track with the new cribbing devices a rooter and a bucket are operated together as a

unit. While the pulling work can be done with one tractor winch, this means that after each movement through a crib both the rooter and the bucket must be carried back across the track. A more efficient arrangement is to use two tractor winches, one on each side of the track, so that when either the rooter or the bucket has passed through a crib it is merely turned end for end and headed through the next crib in the opposite direction. Under this arrangement each tractor winch is alternately pulling the rooter and then the bucket.

What Tractor Winch?

Considerable attention has been given the matter of obtaining the most effective tractor winch combination for this class of work. A consideration to be borne in mind in this connection is that the angle of pull on the cribbing devices must be kept below the base of rail to keep them from binding on the rail. One of the tractors used to date is a Caterpillar D-4 unit with a side boom and winch, from which the boom was removed to adapt the machine to the operation of pulling the cribbing devices. The width of this tractor between the centers of the treads is 60 in. Another machine used for this operation is a smaller D-4 (width 44 in.) with a rear-end winch, which was adapted to the work by running the cable from the winch through a pipe underneath the tractor to a sheave mounted on one side of the machine.

When a tractor with a side-mounted winch is used for this purpose it is apparent that it is not possible for the machine to operate on the track shoulder, the reason being that the clearance is not sufficient to permit the rooter or the bucket to be pulled entirely clear of the track. Hence it is necessary for the tractor with a side winch to operate from a point somewhat beyond the shoulder, a fact that imposes certain difficulties, especially if the track is on a fill of any considerable height. In the latter instance it may be necessary to transmit instructions to the tractor operator by means of hand signals.

Rear-Mounted Winch

These considerations have led the railroad to investigate the possibility of mounting a winch on the rear of a small tractor in such a manner that, with the machine operating on the shoulder, there will be sufficient clearance to permit the rooter and bucket to be pulled into the clear of the track back of the tractor. Thus, the operator will always be able to observe the work himself instead of having to rely on hand signals when working on high fills or other unfavorable terrain. Already a winch of this type has been developed and mounted on the rear of a D-4 tractor with a width of 44 in., and is now being tested.

In This View the Bucket Has Just Passed Through a Crib and the Rooter Is in Line to Enter One

The Cribbing Organization

The organization that has been developed on the Pere Marquette for operating one unit of the new cribbing devices—that is, one rooter and one bucket—is composed of 16 men, including the foreman, and contemplates the use of two tractor winches, one on each side of the track, for doing the pulling work. Power machines used other than the two tractor winches include an angle dozer and a portable four-tool compressor. The principal duties of the 15 men in the gang, other than the foreman, are as follows:

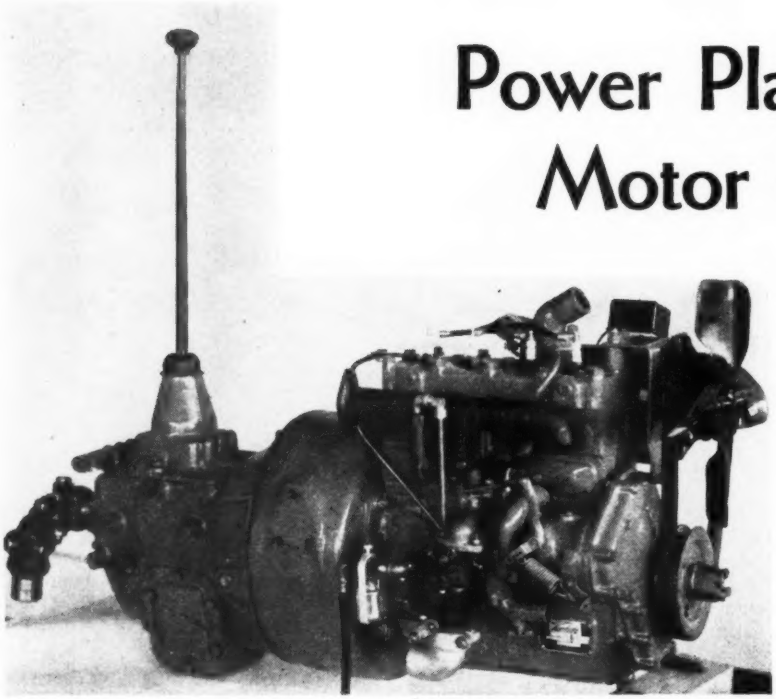
Four trackmen loosening the ballast in the cribs with pneumatic cribbing forks; three machine operators for the angle dozer and the two tractor winches; four trackmen threading the cables under the rails and hooking them to the cribbing devices; two trackmen turning the rooter and the bucket and guiding them into the cribs; one trackman cleaning the remaining ballast from the cribs; and one water boy. The practice, when starting a day's work, is to prepare a considerable length of track for the principal cribbing operation by removing the shoulder ballast with the angle dozer and by using part of the organization, with the two tractor winches and the special scraper shovels, to clear the ballast from the ends of the cribs.

It is expected that when tractor winches especially designed for this type of work become available, it will be possible for the cable and hook on each machine to be handled by one man instead of the two now used. Also, it is felt that a slight increase in cable speed, as compared with that obtained with the machines used to date, would help somewhat to improve the efficiency of the operation.

Experience has shown that the organization described above is capable of cribbing about 1,000 ft. of track in an 8-hr. day. By enlarging the organization to include three units of the cribbing devices—three rooters and three buckets—it is reasoned that it would be capable of cribbing an amount of track equivalent to that for which ballast can be unloaded by one work train. This would also result in a reduction in the unit cost of doing the work because of the spreading of the cost of supervision and the fact that only one angle dozer would be needed for the three units.

Supervision

The work of developing the new cribbing devices and organization in use on the Pere Marquette has been carried out under the general direction of H. A. Cassil, chief engineer, and H. J. Bogardus, assistant chief engineer. As stated, R. A. Morrison, division engineer of the Detroit-Grand Rapids division, conceived the idea and has had direct supervision over the work of developing and perfecting the cribbing devices and the organization that has been set up for operating them.



A Radiator-Cooled, Four-Cycle, Four-Cylinder Engine

Power Plants for Motor Cars

Part I

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No. 5 of a Series

This installment of the series on the selection, care and operation of track motor cars is the first section of a two-part article on motor car power plants. After a brief discussion of the principles of the internal combustion engine, the article describes the design and operation of two-cycle and four-cycle engines in detail, discusses their relative advantages for use in track motor cars, and describes the functions and operation of the various parts comprising the fuel systems in such cars. Part II will discuss cooling systems and power transmission.

THE power plant of a motor car is an internal combustion engine; that is, the power is derived from the expansive force of burning gases within one or more cylinders. This force acts against a movable piston, forcing it away from the head of the cylinder, and the linear motion of the piston is converted into rotary motion of a crank shaft by means of a connecting rod. For the production of power in this way, there are several requisites, including (a) a fuel which of itself is susceptible of rapid combustion under pressure, or which, like gasoline, kerosene and other oils of lower volatility, can be made so by vaporizing and mixing with air; (b) a means of introducing this fuel into the cylinder and compressing it; and (c) a means of igniting it at the proper time. The lubrication of the moving parts and the maintaining of a suitable temperature, or cooling, are subsidiary but very essential requirements. Of the three primary requisites, the best known combination is the use of gasoline for fuel, the introduction of it into the cylinder as will be described later, and igniting it with an electric spark. This is the type of internal combustion power found in the millions of automobiles now being operated in the country, and is the type used in the motor car.

In spite of the fact that the automobile is so common and its operation is so well known that it might be considered unnecessary to discuss the gasoline engine as a source of power, many of those who know well what this type of engine does, give little thought to how and why it does it. Furthermore, as applied to the motor car, it embodies features differing considerably from those that are found in the automobile engine.

In the discussion that follows, the movement of the piston in the cylinder is referred to as "forward" or "advancing" as it moves toward the crank shaft, and "backward" or "receding" as it moves away from the crank shaft and toward the cylinder head. Whether a cylinder is in a horizontal or a vertical position, the power is produced on the forward movement of the piston.

In all internal combustion engines, a complete cycle of operation consists of four fundamental steps: (1) drawing in a charge of combustible gases, (2) compressing the charge, (3) igniting and burning the charge, thus producing the power, and (4) exhausting the spent gases, or scavenging.

Automobile engines, and most other multiple-cylinder gasoline engines, are of the four-stroke-cycle type, generally referred to as four-cycle. In this, there is one stroke of the piston for each of the four fundamental steps referred to above, and consequently only one power impulse from any one cylinder for each two revolutions of the crank shaft. Recent improvements in single-cylinder engines of this type have led to their use on some small motor cars, but the large majority of the single-cylinder motor car engines now in service are of the two-stroke-cycle or two-cycle type.

The Two-Cycle Engine

In the two-cycle engine there is a power impulse for each revolution of the crank shaft; i.e., on each forward stroke of the piston. The intake of the fuel charge and the exhaust of the burned gases take place simultaneously at the end of the power stroke, and are controlled by the movement of the piston over ports or by-pass openings in the cylinder walls. The crank case plays an importat part in the opera-

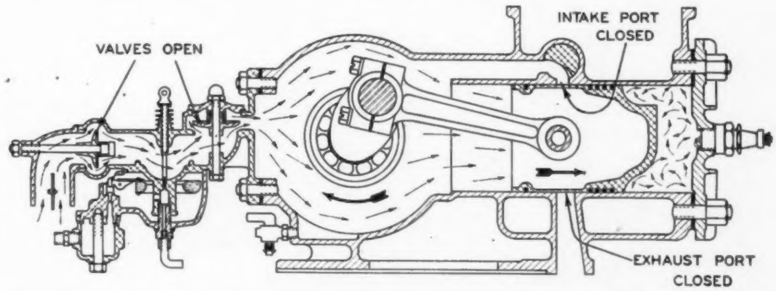
tion as it serves as a reservior from which the fuel is introduced into the the cylinder. Unlike the crank case of the four-cycle engine, it has no breather opening, and is alternately under pressure and partial vacuum, depending on the position and direction of movement of the piston.

The manner in which the four fundamental steps making up the cycle of operation of the engine can be carried out in one revolution of the crank shaft can best be made clear by describing in detail the operation through one complete cycle, noting the function of each part. The operation being continuous, such a description may begin at any point in the cycle, but as action is taking place both in the upper cylinder, or combustion chamber, and in the crank case, it is difficult to describe the steps in the sequence given above; i.e., (1) intake, (2) compression, (3) power, and (4) exhaust. It is chosen, therefore, to start with the beginning of step (3), the power stroke.

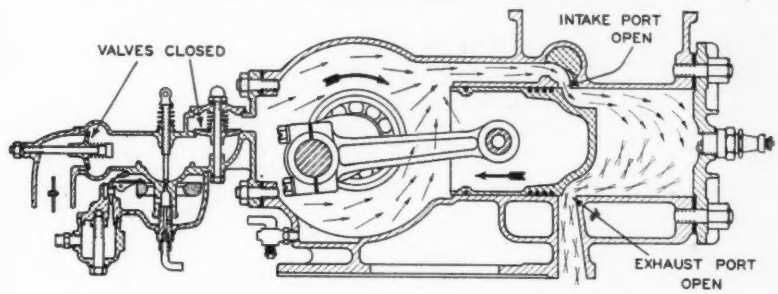
At this point in the cycle, the combustion chamber is filled with burning and expanding gases, giving a power impulse to the piston which is moving forward. The intake and exhaust ports are covered by the piston, and the fuel in the crank case is being compressed. Nearing the end of the stroke, when the expanding force of the burning gases is nearly spent, the piston movement uncovers the exhaust port, permitting the beginning of step (4), the escape of the spent gases. On the side of the cylinder opposite the exhaust port is the intake port through which fresh fuel is admitted to the combustion chamber. The exhaust port, however, opens slightly ahead of the intake port so that by the time the latter is opened, the burned gases have partially escaped through the exhaust port, relieving the pressure in the combustion chamber.

As the intake port is uncovered, the pressure in the crank case forces fresh fuel into the combustion chamber, starting step (1), the intake. An important feature in this action is the baffle on the top of the piston at the intake port side. The fuel, striking this baffle, is deflected backward, and thereby not only prevented to a considerable extent from mixing with the burned gases, but is actually made to assist in driving them out. When the piston has reached the end of its travel, the pressure in the crank case has been relieved, both it and the combustion chamber have been filled with fresh fuel and stps (3), (4) and (1) completed.

The intake and exhaust ports are soon covered as the piston starts to move backward, and step (2), the compression of the fuel charge in the combustion chamber, begins. At the same time the backward moving piston is tending to create a vacuum in the crank case, thus drawing fresh fuel into that chamber. As the piston reaches the end of its travel, the fuel charge in the combustion chamber has been compressed and is ignited, thus completing the cycle.

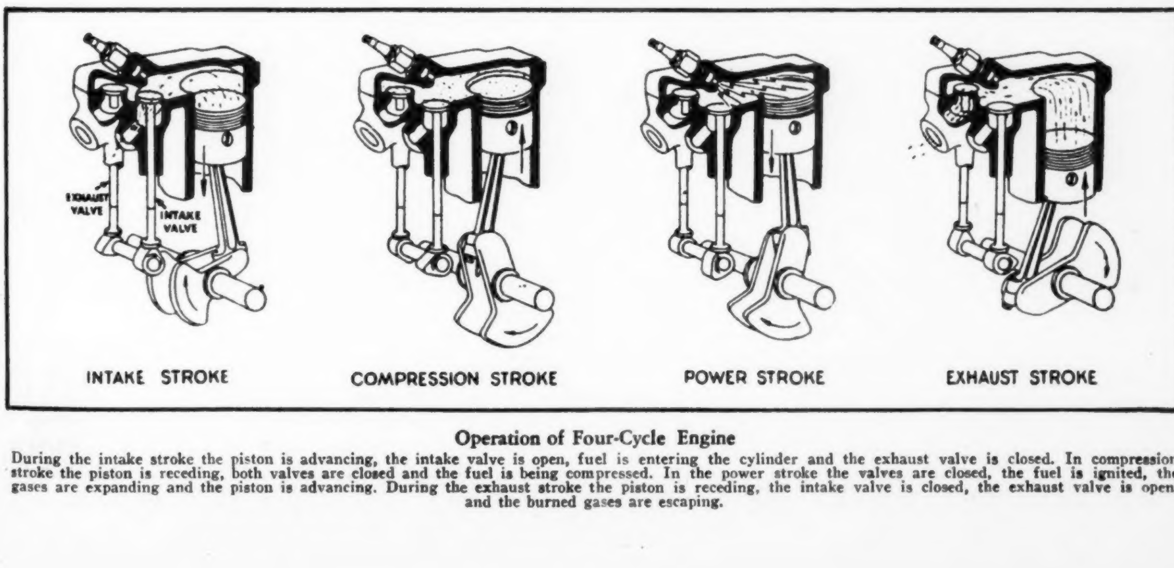


Showing the Operation of a Two-Cycle Engine. Above—Nearing the End of the Compression Stroke. Below—The End of the Power Stroke



Two Types

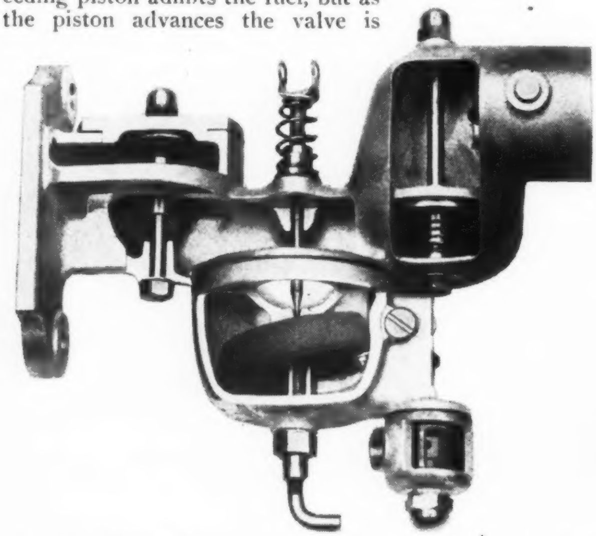
Two-cycle engines are of two types, distinguished principally by the manner in which the fuel is ad-



Operation of Four-Cycle Engine

During the intake stroke the piston is advancing, the intake valve is open, fuel is entering the cylinder and the exhaust valve is closed. In compression stroke the piston is receding, both valves are closed and the fuel is being compressed. In the power stroke the valves are closed, the fuel is ignited, the gases are expanding and the piston is advancing. During the exhaust stroke the piston is receding, the intake valve is closed, the exhaust valve is open, and the burned gases are escaping.

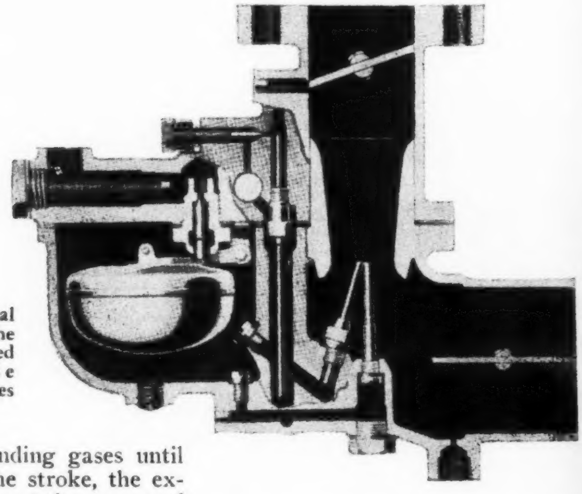
mitted to the crank case. In the description given above of the cycle of operation, no mention was made of a means to prevent the fuel from returning from the crank case to the carburetor or mixing valve as the advancing piston created pressure in the crank case. This is accomplished in one of two ways. In the two-port engine, a check valve opened by the suction created by the receding piston admits the fuel, but as the piston advances the valve is closed by the back pressure, the closing being accelerated by the action of a spring. In the three-port engine a partial vacuum in the crank case is built up as the piston recedes until, near the end of the stroke, a third port is uncovered, permitting the fuel to rush into the crank case, thus relieving the vacuum. This third port is covered quickly as the piston starts its forward travel, and the fuel is thus entrapped in the crank case. A majority of the two-cycle engines now used on motor cars are of the two-port type.



Left — A Typical Carburetor as Used on a Two-Cycle Motor-Car Engine

The Four-Cycle Engine

As its name implies, the cycle of operation of the four-cycle engine requires four strokes of the piston, each stroke performing one of the four fundamental steps of internal combustion power. The crank case bears no part in the introduction of the fuel into the combustion chamber. It is, of course, essential that the fuel enters at the proper time, and likewise, that the burned gases are driven out when their force is spent. To control these movements, an intake valve and an exhaust valve must be provided for each cylinder. These are of the poppet type and are operated mechanically in step with the movement of the piston in that cylinder. The cycle of operations thus covers the four fundamental steps in sequence: (1) fuel is drawn into the combustion chamber by the forward stroke of the piston, the intake valve being open for that purpose; (2) the fuel charge is compressed by the backward stroke, both intake and exhaust valves being closed; (3) after compression, the charge is ignited and the piston goes forward under the force of the burning and expanding gases until near the end of the stroke, the exhaust valve opens and the escape of the spent gases begins; (4) the exhaust valve remaining open, the piston makes its final backward stroke, during which the combustion chamber is cleared of all the burned gases, and the cycle is completed. In a multiple-cylinder engine of this type, all intake valves open from a common chamber, called the intake manifold, so that the fuel mixture reaching all cylinders is the same. In like manner an exhaust manifold connects all of the exhaust valves to a common point of discharge from the engine.



Right — A Typical Carburetor of the Type That Is Used on Four-Cycle Motor-Car Engines

From the descriptions of the operations given above, it will be seen that the scavenging, or removal of the spent gases, is more direct and complete, and there is less mixing of them with the fresh fuel in the four-cycle engine than in the two-cycle type. For this reason, the four-cycle engine is somewhat more economical in fuel consumption. However, improvements in the design of cylinder head and piston, and in the size and location of ports in modern two-cycle engines have greatly increased their efficiency.

The two-cycle single-cylinder engine has several advantages for use on small motor cars. It runs equally well in either direction, making unnecessary any type of reverse mechanism. It is much simpler in design, containing as it does only about half as many parts as a four-cycle engine; and for the same reason is somewhat more easily maintained, especially by an untrained man. It is, however, less successful as a multiple-cylinder engine as there is often difficulty in maintaining a proper balance between the cylinders; each cylinder and its crank case function as a separate engine, and, for smooth and economical performance, each must receive a like amount of fuel, mixed in exactly the same proportions of gasoline and air.

A flywheel is required on each motor car engine. In it the thrust of the power stroke is received and stored, and during the remaining strokes of the cycle, given out to maintain a smooth rotation. In direct-connected cars, the wheels of the car and the momentum of the car itself perform this function. The greater the number of cylinders the engine has and the higher the speed at which it runs, the smaller is the flywheel that is required. On comparatively slow-turning single-cylinder engines, two rather heavy flywheels are often used.

The Fuel System

The fuel system on the motor car engine comprises a gasoline tank, the necessary fuel lines, a fuel pump if required, a strainer and a carburetor. The fuel tank varies in size with the

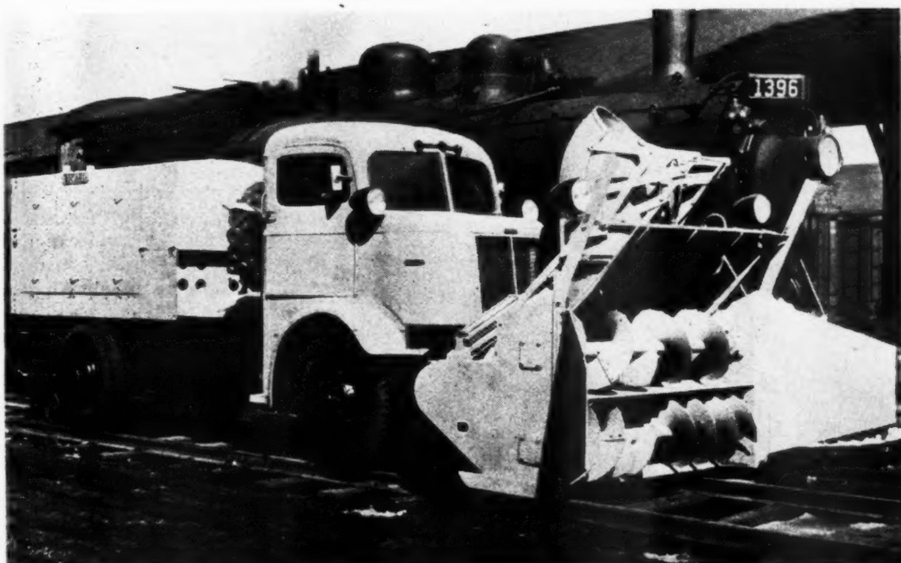
(Continued on page 1128)

This New Snow Blower Is Big Help on CNR

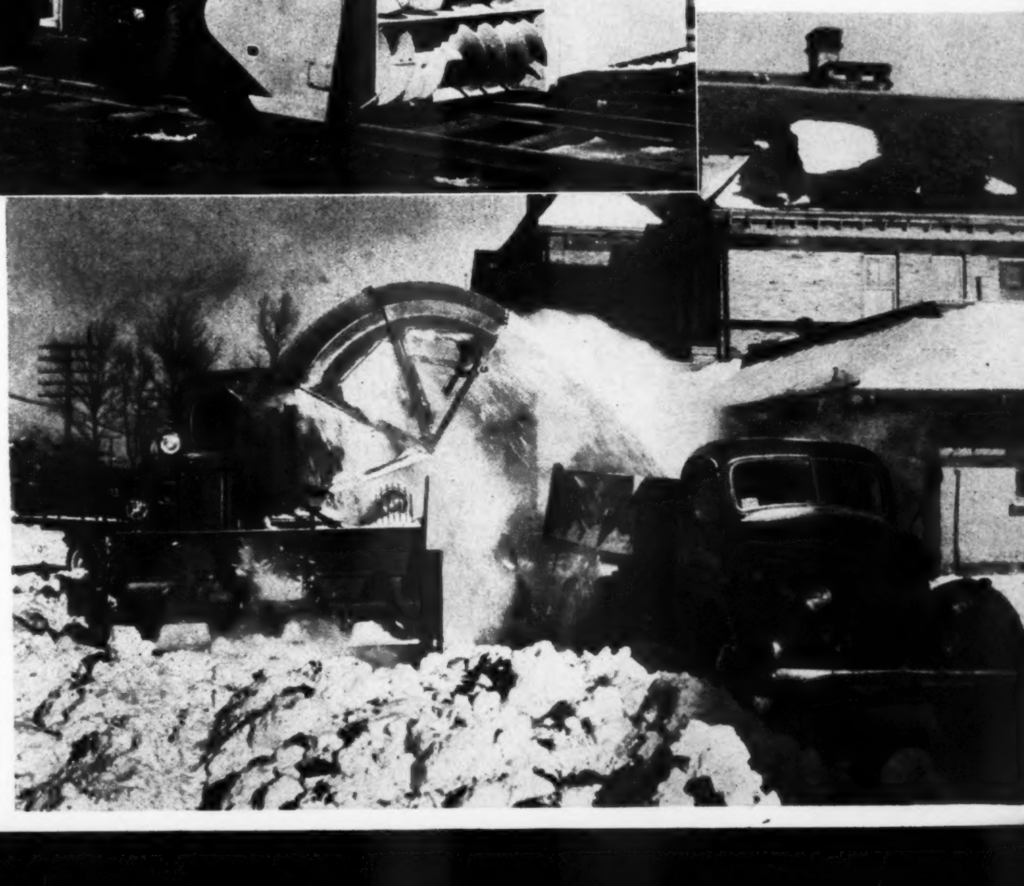
Faced with a shortage of man-power last winter, the Canadian National used an interesting and highly effective machine for clearing its yards and station driveways and platforms at Moncton, N.B. The machine, which is equipped for both on- and off-track operation, can load either directly into trucks or cars, or can be used to throw the snow entirely clear of several tracks. The design of the machine and its method of operation are described in detail in this article.

BECAUSE considerable difficulty was being experienced in securing man-power to remove snow from its yards and station premises at Moncton, N.B., the Canadian National, late last year, decided to make use of power machinery in snow removal work to a larger extent at this point and, to this end purchased a Sicard snow-blower, which was put into operation in December. This machine has a large loading capacity and is quite flexible in operation, being equipped for both on- and off-track operation, and its use during the extremely severe winter of 1944-45 proved very successful.

The Sicard snow-blower consists of a five-ton, gasoline-driven four-wheel traction truck with pneumatic tires, in front of which is mounted what is called the snow-blower assembly. This assembly consists of a loading and blowing unit. The loading unit is essentially a concave-type plow equipped with side wings and two large, horizontal screw conveyors, both of which are "H"-type double spirals 20 in. in diameter and 8 ft. long. These screw conveyors, mounted one above the other, revolve and force the snow toward an opening in the center of the plow and into the blowing unit, which is a turbine 15 in. wide by 38 in. in diameter. The snow tur-



Above — Three-Quarter View of Snow-Blower, Showing the Snow Blower Assembly



Right — Loading Snow Into a Truck at Moncton, N.B.

bine expels the snow up and out through an adjustable spout or chute. The entire unit weighs 25,000 lb. and is 27 ft. long, without the front wings, which add another 3 ft. to the length of the machine.

Hydraulic Controls

The snow-blower assembly is powered by a separate Buda Diesel-engine of 150 hp., mounted behind the truck cab, which drives the loading unit spirals at 300 r.p.m. and the turbine at 400 r.p.m. Shear pins in the drive shaft couplings prevent damage to the turbine and spirals. All controls on the blower assembly are hydraulic, including two hydraulic jacks which can be used to raise the blower assembly 12 in. above the rails or roadway. The truck itself is powered by a 112-hp. Buda gasoline engine.

For use on the track, two pairs of flanged wheels are provided, one pair in front of the forward truck wheels and the other pair immediately behind the rear truck wheels. The rubber tires of the truck rest directly on the tops of the rails to provide traction and the purpose of the flanged wheels is merely to keep the machine on the rails. When operating on the track, the front truck wheels are locked with the front pair of flanged wheels, eliminating the use of the steering wheel. Raising and lowering of the flanged wheels is also controlled by means of hydraulic action.

Large Loading Capacity

In operation, the machine is pushed into a bank of snow somewhat like a bulldozer or plow, but instead of pushing the snow ahead, the snow-blower assembly draws the snow in and throws it up and out to one side in a continuous stream, a distance from 5 to 125 ft. This machine can load 20 cu. yd. of snow a minute, a 5-cu. yd. truck with from 1,500 to 2,000 lb. of snow in 30 sec., and a railway ballast car in from 5 to 7 min. When loading in shallow snow, the unit will operate at speeds up to 10 m.p.h., while in heavy snow, up to a depth of 4 ft., it will operate at speeds from 1½ to 5 m.p.h. When not loading, the truck can travel at speeds as high as 35 m.p.h. By adding alloy steel scarifying attachments to the lower loading spiral, the machine can be made to cut its way through 18 in. of frozen snow.

In clearing railway yards, the machine is frequently operated in conjunction with a Jordan spreader. The spreader is used to heap the snow between the rails on every third or fourth track for the blower to pick up and load into cars placed on an adjacent track. The blower can also be used, if desired, to blow the snow from track to track, or across several tracks, and then blow it from the last track onto the ground, clear of the yard.

In other snow removal operations, around station driveways, platforms, etc., a bulldozer is used to push the snow into piles so the snow-blower can pick it up more easily and load it into trucks, or throw it onto an adjacent area where it will not interfere with railway operations.

Better Safety Instruction Means Fewer Personal Injuries*

By T. F. LANGAN,
Track Supervisor,
Central Railroad of New Jersey,
Jersey City, N.J.

TO OBTAIN the best results in teaching safety to his men the foreman must plan his safety campaign with two very definite objectives in mind—(1) to familiarize each man thoroughly with the hazards involved in his work; and (2) to give him a thorough understanding of how to protect himself and his fellow workers against personal injury. Any program for teaching employees safe working practices should involve instruction to the men, both in groups and individually, along the following lines:

(A) The foreman should review the safety rules with all the men in his gang, discussing each rule separately and the manner in which it can be applied most effectively. In so doing the foreman should encourage each man to raise any questions that may come to mind, and he should also satisfy himself that each rule is fully understood by all the men.

(B) In addition to periodic group instruction, those men who appear to be slow in absorbing rules of safety should have the rules emphasized to them again and again until they have fully mastered them.

(C) When new men are added to the gang they should be given special instruction in safety until they have become familiar with all the rules. If there is only one new man it is a desirable policy to place him at work alongside an experienced employee who has shown himself to be safety-minded.

Each foreman should establish the practice of devoting about ten minutes at least once a week to a systematic review of the safety rules with his entire gang. Rainy days may be selected for this purpose. A good practice in this connection is for the foreman to keep a record in his book of safety rules, of the date on which each rule was discussed with his men. When all of the rules have been discussed the process of reviewing them should be repeated. When talking about safety matters with his group the foreman should do everything he can to get the men interested in the subject and to build up in them a desire to become familiar with all the factors involved in working safely. Also, each man must be checked frequently to be sure that he is acquiring safe habits.

Pointers for Foremen

During the periods that are set aside for the discussion of safety it will be helpful if the foremen can make each man feel at ease. At all times the foreman should guard against using improper or boisterous language and should be particularly careful to avoid the use of profanity. In all human beings, the emotions, the state of mind and the physical condition of the body have a definite relationship to each other; when one of these is disturbed the other two will also be affected. When improper language is used by a foreman or supervisor it may act as a mental shock to the worker, upsetting his emotional equilibrium and possibly even his digestion. If such language is used over a period of time it may have the effect of causing the worker to become highly nervous, and it is a well known fact that a nervous employee is not a safe worker and, therefore, not a desirable man to have in the organization. Thus, when this happens, it means that all previous efforts to teach the man to become a safe worker have been nullified to a large extent.

*This article was originally submitted for use in the What's the Answer Department, but because of its scope it is presented here as a separate article.

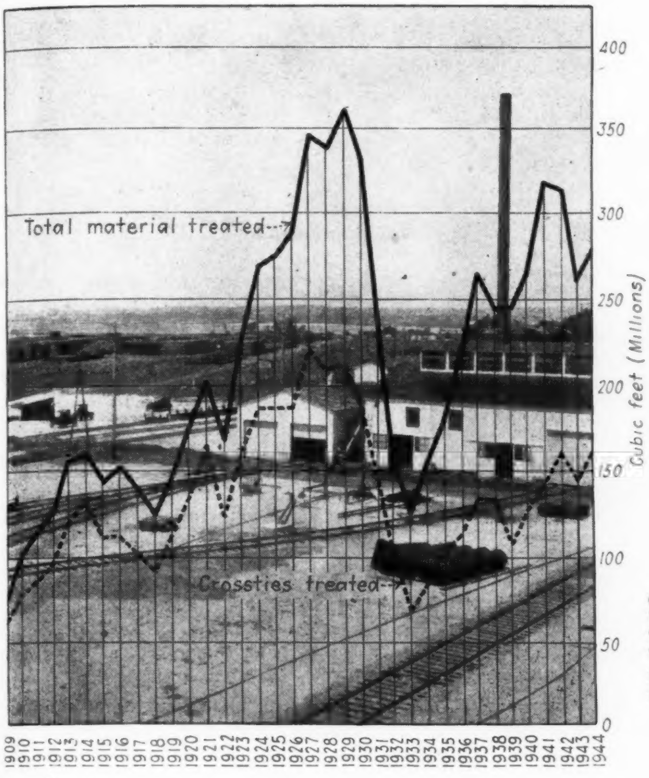


Chart Showing Volume of Ties and All Wood Treated in U. S. Since the year 1909

In spite of the fact that war-time restrictions and labor shortages continued to prevent full use of forest products for civilian purposes, the amount of wood given preservative treatment in 1944 was six per cent greater than in the previous year. While this was only a mild recovery, the volume of wood treated last year has been exceeded in only two years since 1930 and only seven times since the compilation of these statistics was started 36 years ago.

Wood Preservation Resumes Upward Trend

ALTHOUGH government restrictions on civilian uses of forest products remained in effect throughout the year, and although the labor stringency was nowise relaxed, the volume of wood treated during 1944 increased by six per cent, compared with 1943. There are strong indications that this reversal of the downward trend that continued during the war years is only the beginning of an era of recovery and expansion that will return wood preservation to the position it held prior to the depression.

Increase Not General

It is well to note, however, that this increase was not general but was confined to three classifications. In part, the decreases in some of the remaining classifications occurred by reason of the large reduction, aggregating 90 per cent, in the amount of material given fire-retardant treatment. Despite this slight upward turn from the very evident downward trend since 1941, which resulted from the severe restrictions imposed by the government priority system and the inability to get labor in the producing areas, the volume of wood treated in 1944 has been exceeded only twice since 1930 and only seven times in the 36 years that these statistics have been compiled.

A total of 277,686,727 cu. ft. of wood was given preservative and fire-retardant treatment during 1944, this being an increase of 16,547,747 cu. ft. over the 261,138,980 cu. ft. that was given similar treatments in 1943, according to figures compiled by R. K. Helphenstine Jr., Forest Service, United States Department of Agriculture, in co-operation with the American Wood-Preservers' Association.

For statistical purposes, the material treated year by year is divided into eight classifications. In 1944 increases were recorded in three of these classifications, namely crossties, poles and cross arms, while the remaining five—switch ties, piles, wood blocks, construction timbers and miscellaneous material—all registered decrease, ranging up to 69 per cent in the case of wood blocks.

Railways Biggest Consumer

As in all previous years since the beginning of the wood-preserving industry, the railways maintained their position as the principal consumer of treated timber. Previous to 1939 this position had been assured by the fact that crossties alone constituted more than 50 per cent of the total volume of timber treated each year, and only the railways use ties. However, in 1939, in 1940, and again in 1941, crossties fell below 50 per cent of the total volume of wood treated, indicating that the consumption of products in other classifications was gaining faster than that of ties.

Yet, even during these three years, when switch ties, piles, poles, construction timbers and other items were added, the railways consumed more than two-thirds of the total volume of wood treated. Beginning in 1942, ties again represented more than 50 per cent of the total volume of wood treated. In 1943 the ratio of ties to all wood treated rose to 55.4 per cent, while the addition of switch ties brought the combined ratio to 59.8 per cent, and the railways consumed more than the customary two-thirds of the wood treated during the year. In 1944 the corresponding ratios for ties and for ties and switch ties combined, was 57.3 and 61.2, while the consumption of all classes of treated wood ran well above 70 per cent.

In 1944 a total of 53,044,598 crossties was given preservative treatment, representing 159,133,794 cu. ft. This was an increase of 4,815,531 ties, 14,446,593 cu. ft., or 9 per cent, compared with the 48,229,067 ties, or 144,687,201 cu. ft., treated in 1943. As in 1943, oak ties ranked first in number, with 18,511,304 ties, or 34.9 per cent of the total number treated, compared with 17,285,803, or 34.8 per cent, in 1943. Southern pine remained in second place, with 12,046,136 ties, or 22.71 per cent of the total, compared with 11,155,700 ties, or 23.1 per cent, in 1943. Douglas fir again ranked third, with 6,737,109 ties, or 12.7 per cent of the total, compared with 5,355,760 ties, or 11.1 per cent, of this species treated in 1943. Gum also remained in fourth place, 5,540,479 ties, or 10.44 per cent, compared with 4,604,653 ties, or 9.5 per cent in 1943.

Other woods treated for crosstie purposes in 1944 included beech, tamarack, lodgepole pine, maple, ponderosa pine, birch, hemlock and elm, in the order given, aggregating 7,428,309, or 14.01 per cent of the total. In addition, a few miscellaneous species accounted for 2,781,261 ties, or 5.24 per cent of the total number of crossties that were given preservative treatment during the year.

Of the total number of crossties treated last year, 31,472,309, or 59.33 per cent, were treated with straight creosote or solutions of coal tar and creosote; 21,165,744 ties, or 39.9 per cent, were impregnated with solutions of creosote and petroleum; and 376,876 ties, or 0.71 per cent, were treated with either zinc chloride or chromated zinc chloride. All other preservatives accounted for only 29,669 ties, or 0.07 per cent, of the total number of ties given preservative treatment during the year. All ties were treated by pressure processes.

Wood Preservation, 1909-1944
Together with Consumption of Creosote and Zinc Chloride

Year	Total material treated cu. ft.	Number of crossties treated	Creosote used, gal.	Zinc chloride used, lb.*
1909	75,946,419	20,693,012	51,426,212	16,215,107
1910	100,074,144	26,155,677	63,266,271	16,802,532
1911	111,524,563	28,394,140	73,027,335	16,359,797
1912	125,931,056	32,394,336	83,666,490	20,751,711
1913	153,613,088	40,260,416	108,373,359	26,466,803
1914	159,582,639	43,846,987	88,764,050	27,212,259
1915	140,858,963	37,085,585	84,065,005	33,269,604
1916	150,522,982	37,469,368	96,079,844	26,746,577
1917	137,338,586	33,459,470	83,121,556	26,444,689
1918	122,612,890	30,609,209	56,834,248	31,101,111
1919	146,060,994	37,567,927	67,968,839	43,483,134
1920	173,309,505	44,987,532	70,606,419	49,717,929
1921	201,643,228	55,383,515	77,574,032	51,375,360
1922	166,620,347	41,316,474	87,736,071	29,868,639
1923	224,375,468	53,610,175	128,988,237	28,830,817
1924	268,583,235	62,632,710	158,519,810	33,208,675
1925	274,474,539	62,563,911	169,723,077	26,378,658
1926	289,322,079	62,654,538	188,274,743	24,777,020
1927	345,685,804	74,231,840	221,167,895	22,162,718
1928	335,920,379	70,114,405	222,825,927	23,524,340
1929	362,009,047	71,023,103	226,374,227	19,848,813
1930	332,318,577	63,267,107	213,904,421	13,921,894
1931	233,334,302	48,611,164	155,437,247	10,323,443
1932	157,418,589	35,045,483	105,671,264	7,669,126
1933	125,955,828	22,696,565	85,180,709	4,991,792
1934	155,105,723	28,459,587	119,049,604	3,222,721
1935	179,438,970	34,503,147	124,747,743	4,080,887
1936	222,463,994	37,952,129	154,712,999	4,127,886
1937	265,794,186	44,803,239	183,574,581	4,833,935
1938	244,221,442	44,598,678	166,183,891	4,829,590
1939	245,219,878	35,748,845	163,864,259	4,522,070
1940	265,473,149	42,666,598	174,625,305	5,180,896
1941	319,164,422	47,664,019	215,467,780	5,786,424
1942	312,934,621	54,175,380	216,347,768	5,051,263
1943	261,138,980	48,229,067	177,786,315	3,122,302
1944	277,686,727	53,044,598	188,758,182	2,836,420

* Includes chromated zinc chloride.

In the preparation of these ties for treatment, 34,490,239, or 65 per cent, were adzed and bored prior to treatment, compared with 29,379,391, or 60.9 per cent, in 1943; 1,206,890 ties, or 2 per cent, were adzed but not bored, compared with 603,146, or 1.3 per cent, in the previous year; 2,637,311 ties, or 5 per cent, were bored but not adzed, compared with 3,112,848, or 6.5 per cent, in 1943; and 14,710,158 ties, or 28 per cent, were neither adzed nor bored, compared with 15,133,682, or 31.3 per cent, during 1943.

The quantity of switch ties given preservative treatment in 1944 amounted to 132,274,138 ft. b. m., a reduction of 6,724,781 ft. b. m., or 4.8 per cent, from the quantity treated in 1943. As with crossties, oak maintained first place as a material for switch ties, with 73,928,232 ft. b. m., or 55.9 per cent of the total; southern pine remained in second place, with 16,986,620 ft. b. m., or 12.84 per cent; Douglas fir retained third rank, with 15,050,656 ft. b. m., or 11.38 per cent of the total; and gum was again fourth, with 12,718,952 ft. b. m., or 9.62 per cent of the total switch ties treated during the year. Maple, tamarack, beech, birch, elm, ponderosa pine, lodgepole pine and a few miscellaneous species accounted for the remaining 10.3 per cent.

Reflecting a still further reduction in military requirements, piles again registered a considerable reduction in the quantity treated, falling to 27,156,712 lin. ft., a decrease of 3,433,310 lin. ft., or 11.2 per cent, from the 30,590,022 lin. ft. that was treated in 1943. Reversing the relative position they have held for many years, Douglas fir moved up to first place, with 13,978,126 lin. ft., or 51.5 per cent of the total, while southern pine, which has stood well ahead of all other species for many years, stepped down to second place, with 12,778,436 lin. ft., or 47 per cent of the total. The remaining 1.5 per cent was made up of oak, red (Norway) pine and a few miscellaneous species. All but 15,840 lin. ft. were treated by pressure processes, while 26,730,550 lin. ft., or 98.5 per cent, were impregnated with creosote or with solutions of creosote and coal tar, and 395,156 lin. ft. were treated with solutions of creosote and petroleum. The remaining 31,006 lin. ft. were treated with chromated zinc chloride and miscellaneous preservatives.

Beginning with the war, in addition to the normal preservative treatments which have been given wood for many years, a large quantity of wood was given fire-retardant treat-

Treatment of Miscellaneous Material—Ft. b. m.

	1944	1943	1942	1941
Lumber	197,613,878	270,525,549	287,191,977	281,006,886
Fence posts	40,319,095	21,255,494	37,401,538	28,061,805
Tie plugs	3,514,076	2,146,370	1,694,468	2,222,766
Crossing plank	None reported	None reported	None reported	1,360,584
Car lumber	183,320	159,792	272,103	220,668

Number of Crossties Treated by Kind of Wood and Kind of Preservative—1944

Kind of wood	Creosote (1)	Creosote petroleum (2)	Zinc chloride	Wolman salts	Chromated zinc chloride	Misc. preservatives	Total	Per cent of total
Oak	15,128,988	3,381,751	....	....	565	....	18,511,304	34.90
Southern pine	8,199,980	3,845,831	....	325	....	....	12,046,136	22.71
Douglas-fir	477,657	6,158,578	71,530	24,868	....	4,476	6,737,109	12.70
Gum	4,591,743	948,736	....	....	....	....	5,540,479	10.44
Beech	450,918	779,411	....	....	....	....	1,230,329	2.32
Tamarack	....	1,213,053	....	....	....	....	1,213,053	2.29
Lodgepole pine	....	910,090	164,247	....	....	....	1,074,337	2.03
Maple	480,543	537,688	....	....	....	....	1,018,231	1.92
Ponderosa pine	....	881,768	100,000	....	....	....	981,768	1.85
Birch	352,860	592,272	....	....	....	....	945,132	1.78
Hemlock	....	654,530	40,534	....	....	....	695,064	1.31
Elm	167,053	103,342	....	....	....	....	270,395	0.51
All other	1,622,567	1,158,694	....	....	....	....	2,781,261	5.24
Total	31,472,309	21,165,744	376,311	25,193	565	4,476	53,044,598	....
Per cent of Total	59.33	39.90	0.71	0.05	(3)	0.01	....	100.00

(1) Includes distillate coal-tar creosote and solutions of creosote and coal-tar.
(2) Includes various-percentage solutions of creosote and petroleum.
(3) Less than 0.005 per cent.

ments, primarily as a result of accelerated demands incident to the war to make fire-resistant construction possible without the use of critical materials. This movement reached its peak in 1943 when 65,636,518 ft. b. m. were so treated. With the requirements of the navy, which was the largest user of fire-resistant wood, satisfied, the demand dropped off to 8,527,428 ft. b. m. in 1944, a reduction of approximately 90 per cent as compared with 1943.

Preservatives Consumed

During 1944 the wood-preserving industry consumed 188,758,182 gal. of creosote, an increase of 10,971,867 gal., or 6.2 per cent, compared with the 177,786,315 gal. consumed in 1943. It is of interest to note that the amount of creosote consumed in 1944 has been exceeded only twice since 1930 and only six times in the 36 years that these records have been compiled. Solutions of creosote and petroleum consumed 33,908,339 gal. of petroleum, compared with 28,439,733 gal. in 1943, in the preparation of 67,733,132 gal. of creosote-petroleum solutions.

The wood-preserving industry also consumed 671,385 lb. of zinc chloride in 1944, which was 343,361 lb. less than was consumed during the previous year. There was a slight gain in the consumption of chromated zinc chloride, which rose from 2,107,556 lb. in 1943 to 2,165,035 in 1944, representing a gain of 57,479 lb. Of these amounts, 31,173 lb. of zinc chloride and 158,900 lb. of chromated zinc chloride were used in fire-retardant treatment.

The consumption of Wolman salts gained 12,940 lb., rising from 769,316 lb. in 1943 to 782,256 lb. in 1944. Zinc meta arsenite fell from 53,516 lb. in 1943 to 11,503 lb. in 1944, a decrease of 42,013, while there was a reduction of 29,615 lb. in the consumption of Celcure, from 134,827 lb. in 1943 to 105,212 in 1944.

In addition to the preservatives already mentioned, 2,315,830 lb. of miscellaneous salts were consumed in 1944, compared with 20,932,510 lb. in 1943, a decrease of 18,616,680 lb., which was almost entirely the result of the reduction in fire-retardant treatments. In 1943, 20,603,702 lb. of these salts were used in fire-retardant treatments, leaving 328,808 lb. that were used as preservatives. In 1944, a total of 1,921,894 lb. of miscellaneous salts were used for fire-retardant purposes, leaving 393,936 lb. for use as preservatives.

During 1944, there were 235 treating plants in existence, one more than in 1943. Of these 222 were active, 11 were idle and 2 were abandoned, and 2 plants were constructed during the year. Of the idle plants, 6 were of the non-pressure (open-tank) type, 4 were pressure plants, and 2 had facilities for treatment by both the pressure and non-pressure processes. Of the total number of plants in existence during the year, 189 were commercial plants that treat wood for sale or by contract; 22 were owned and operated by the railways; and 24 were owned and operated by public utilities, mining companies and others to supply their own needs.

1944 Rail Output Highest in 15 Years

CLIMBING to a new high since 1929, the production of rails in the United States in 1944 totaled 2,490,656 net tons, a gain of 363,660 tons, or 17.1 per cent, as compared with 1943, according to figures published in the annual statistical report of the American Iron and Steel Institute for 1944. Although this is the sixth successive year in which the rail production has registered a gain over the preceding year, the total for 1944 was still substantially below that of a number of years in the Twenties, including 1926, when it was 3,603,767 net tons.

The production of rail in 1944 and in previous years back to 1927 is shown in an accompanying table in which the output for each year is broken down into four weight groupings. It will be seen from a

Production of Rails by Weight Per Yard—Net Tons

Year	60 lb. or less	Over 60 and less than 100 lb.	100 and less than120 lb.	120 lb. and over	Total
1927	*181,256	†798,226	1,472,155	691,627	3,143,264
1928	*150,301	†662,053	1,348,199	804,639	2,965,192
1929	*158,326	†574,080	1,381,631	934,758	3,048,795
1930	*107,101	†391,079	935,756	664,085	2,098,021
1931	*56,100	†166,793	555,242	518,546	1,296,681
1932	*18,654	†47,374	240,902	143,944	450,874
1933	55,010	63,153	172,488	175,601	466,252
1934	78,495	101,640	550,639	400,677	1,131,451
1935	63,982	112,431	381,696	238,812	796,921
1936	107,644	135,585	684,910	438,089	1,366,228
1937	113,889	218,374	815,280	471,685	1,619,228
1938	50,375	85,177	371,534	190,556	697,642
1939	92,994	83,611	620,992	515,050	1,312,647
1940	140,443	339,672	688,109	510,762	1,678,986
1941	172,264	323,968	820,695	610,924	1,927,851
1942	124,938	438,562	924,851	607,808	2,096,159
1943	164,096	364,715	847,839	750,346	2,126,996
1944	162,942	401,213	1,032,256	894,245	2,490,656

* Under 50 lb. per yd.
† 50 and less than 100 lb. per yd.

study of the table that the production of all classifications of rail, except 60-lb. or less, increased materially, as compared to 1943. It is significant, however, that the production of rails in the two heaviest weight groups increased much more, proportionately, than in the next lighter weight group. Specifically, the weight group including rail sections of 120 lb. or over increased from 750,346 tons in 1943 to 894,245 tons in 1944, or 19.2 per cent, and the rail tonnage produced in the group weighing 100 lb. and less than 120 lb. increased from 847,839 tons in 1943 to 1,032,256 tons in 1944, or 21.8 per cent, while production of the group weighing more than 60 lb. and less than 100 lb. increased only 10.1 per cent in 1944, compared with 1943. The group weighing 60 lb. and less decreased 0.7 per cent compared with 1943.

Largely Open-Hearth Steel

Of the total tonnage of rails produced in 1944, 2,419,969 tons, or 97.2 per cent, were rolled from open-hearth steel. Only 14,261 tons of rails were rolled from Bessemer and electric steels in that year, compared with 23,747 tons in 1943, marking a reversal in the tendency for the tonnage in this category to increase that had been in evidence for several years prior to 1944. Also included in the total output for 1944 were 49,399 tons rolled from old rails and 22,411 tons of girder and high tee rails.

As with the production of rails, the output of fastenings in 1944 showed a substantial increase, rising from 665,956 tons in 1943 to 807,066 tons in 1944, an increase of 21.2 per cent. The total output of fastenings in 1944 included 179,315 tons of joint or splice bars, 65,590 tons of other rail joints, and a total of 562,161 tons of tie plates.

Power Plants for Motor Cars

(Continued from page 1122)

type of engine and car. It usually has sufficient capacity for 50 to 75 miles of operation. It is made of copper, galvanized iron or terne plate, the latter being preferred. The fuel tank is often mounted over the engine or under the seat deck in such a manner that the gasoline flows by gravity to the carburetor. If not so mounted, a fuel pump is necessary to insure a continuous supply of fuel to the carburetor. Fuel pumps are not widely used except on special-duty cars such as, for example, those used for inspection parties; in such cars, the usual mounting of the tank is objectionable because it occupies space needed for other purposes. A shut-off cock should be, and usually is, placed in the fuel line, preferably immediately under the tank so that the gasoline can be shut off to permit cleaning the fuel line, strainer and carburetor. The strainer should be mounted in the fuel line next to the shut-off cock; this keeps out any foreign matter that might clog the fuel line. Originally, the fuel line was of rubber tubing but this was short lived as the gasoline caused rapid deterioration of the rubber. Annealed copper tubing was then used for many years. Even when the fuel tank is mounted directly over the engine, the fuel line is subjected to much vibration and, under such conditions, the copper becomes work-hardened and brittle. With the increasing trend toward mounting the tank under the seat deck, the demand for more flexibility in the fuel line has led to the use of oil-resisting synthetic rubber. Tubing molded from flexible plastic was introduced early during the war because of limitations placed on the use of both copper and synthetic rubber.

Carburetion

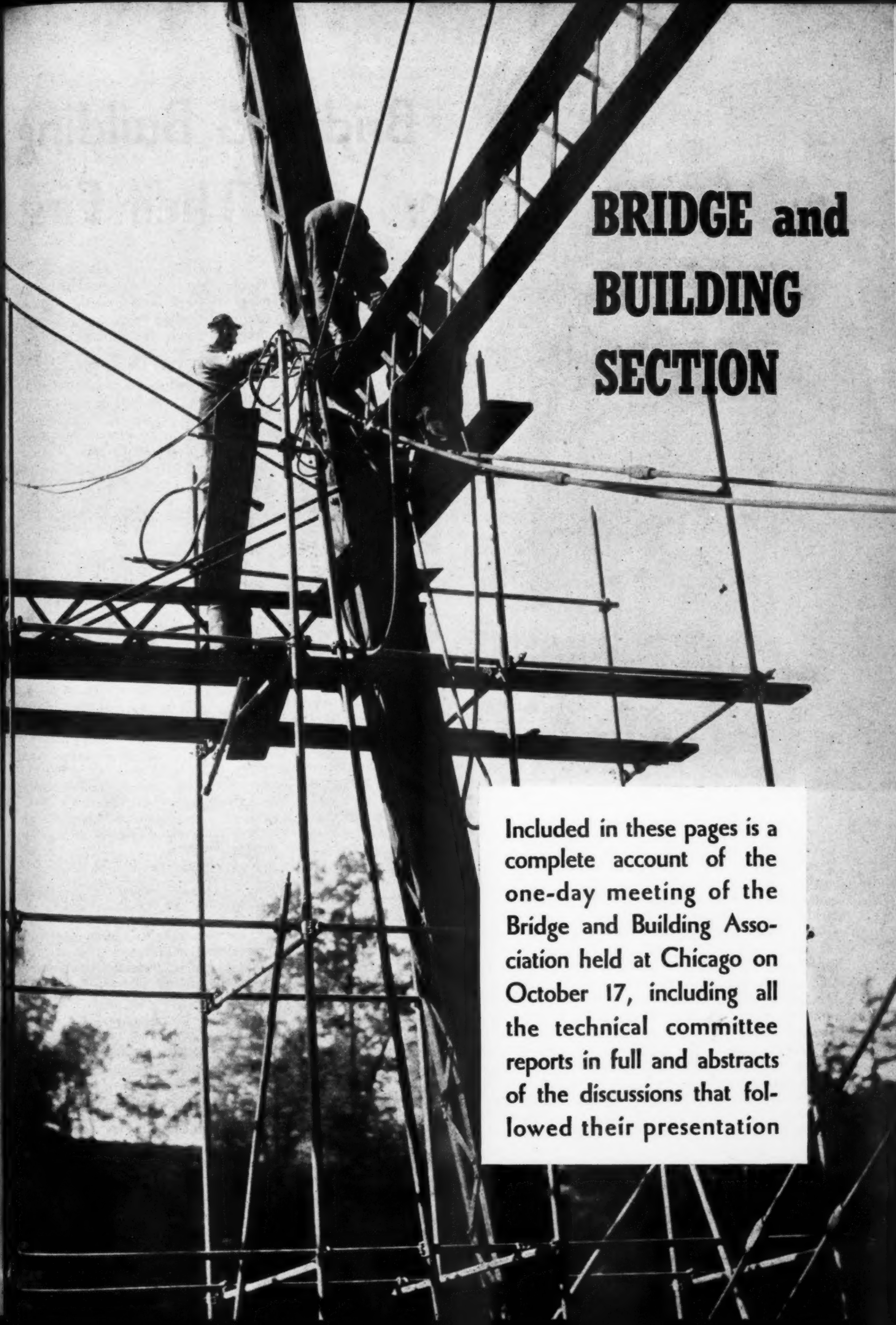
Since the gasoline in the fuel tank is in liquid form, it is not suitable for the operation of the engine, and must, before it is introduced into the cylinder, be vaporized and mixed with air in such proportions as to form a gas that is so highly combustible that it will burn quickly and completely while under pressure. This treatment of the fuel is called carburetion and is carried out in the carburetor. In its simplest form, the carburetor consists of (a) a float chamber to which the gasoline is admitted from the fuel line through a valve controlled by a float in such a way that the gasoline stands at the same depth in the chamber at all times; (b) a mixing chamber to which air is admitted through an air valve; and (c) between the two, one or more jets or nozzles through which the gasoline is drawn into the mixing chamber. Both gasoline and air are drawn into the mixing chamber by the suction of the engine. Ordinarily the air valve permits the free entrance of air, but when, as in starting a cold engine, a richer fuel mixture is wanted momentarily, the air valve or choke can be closed, whereupon a greater part of the suction is exerted on the jet and a larger proportion of gasoline is drawn from the float chamber.

Even on a motor car engine, which, by reason of the nature of its use, must remain simple in construction, the carburetor may often be much more complicated than that described above. While the proportions of gasoline vapor and air reaching the combustion chamber may vary considerably and the engine still run, a nice balance in the mixture is desirable for both reliable performance and economy of fuel. The design or selection of a suitable carburetor for a particular design of motor car engine is considered of much importance by engine builders.

Throttle

In order that the amount of fuel vapor reaching the combustion chamber may be increased or reduced as may be desired, a valve called a throttle is provided. On a four-cycle engine, the throttle is built into the carburetor, while in the two-cycle engine it is placed in the by-pass by which the fuel moves from the crank case to the intake port. In either case, a lever for opening and closing the throttle is required. On most motor cars this lever is mounted on the seat deck of the car for convenient hand operation, although a foot pedal, as used on automobiles, is sometimes used, especially on party inspection cars.

The equipment required for igniting the fuel charge in the combustion chamber and the methods of lubricating the engine vary with the type of engine and other considerations. A detailed discussion of these important subjects will appear in later articles in this series.



BRIDGE and BUILDING SECTION

Included in these pages is a complete account of the one-day meeting of the Bridge and Building Association held at Chicago on October 17, including all the technical committee reports in full and abstracts of the discussions that followed their presentation

Bridge & Building
Their First

WITH a confidence born of its achievement in surviving the difficulties of the war years with undiminished vitality, the American Railway Bridge and Building Association has already established the basis for a determined, aggressive attack on the problems of the future. Evidence to substantiate this conclusion was manifest on every hand at the one-day annual meeting of the association at the Stevens hotel, Chicago, on October 17, where nearly 100 members and guests tackled a crowded schedule of work that consisted, first, of clearing the docket of all current business, and then of planning the activities for the coming year. Throughout the day the atmosphere was permeated with a spirit of confidence in the ability of the association, and its members, to prove more than equal to any problems that the future may have in store for them.

As held, this meeting was somewhat broader in scope than the original plans, made before V-J Day, contemplated. At that time it was intended that attendance at the meeting would be confined to members of the Executive committee, the chairmen of technical committees, and members in the Chicago area, but when the Office of Defense Transportation removed its restrictions on the holding of conventions, the scope of the attendance was broadened considerably, although no effort was made to expand the program beyond the one-day meeting planned originally. Considering the difficulties of travel these days and the fact that bridge and building officers have not as yet experienced any appreciable lessening of the heavy burdens that have kept them so closely on the job in recent years, the attendance at the meeting was gratifying evidence that the membership as a whole is eager to participate in the activities of the association.

This marked the third consecutive year that the annual meeting has been confined to something less than the full-scale, three-day convention that is normally held in peace time. Last year the meeting was also restricted to one day, while in 1943 it took the form of a two-day conference. Notwithstanding this curtailment of its annual meetings, the association has continued to carry on with its most essential activity, namely, studying and reporting on current problems through the agency of technical committees. Thus, at a time when they were beset by a multitude of new and complex problems, the members of the association continued to have the opportunity of studying such problems as part of a group and of reading the resulting reports.

Realizing, however, that the opportunity of participating once in each year in a full and complete discussion of current problems with their associates constitutes one of the most important advantages of membership in the association, the members have been looking forward to the time when the association could again return to the practice of holding three-day annual conventions. Every indication is that that time lies immediately ahead, and plans for the 1946 meeting are proceeding on this basis. These plans, which, incidentally, contemplate an innovation that is expected to meet with general favor, are discussed in more detail later in this article.

A Constructive Meeting

If the amount of work accomplished, and the interest and enthusiasm displayed by those present, can be considered an accurate measure of the value of a meeting, this year's affair was one of the most constructive ever held by the association. The work accomplished included the pres-

Bridge and Building Association

Officers 1944-45

J. L. Varker, president, supvr. b.&b., D.&H., Carbondale, Pa.

R. E. Caudle, first vice-president, prin. asst. engr., M.P. Lines, Houston, Tex.

N. D. Howard, second vice-president, editor, *Railway Engineering and Maintenance*, Chicago.

F. G. Campbell, third vice-president, asst. ch. engr., E. J. & E., Joliet, Ill.

J. S. Hancock, fourth vice-president, br. engr., D.T.&I., Dearborn, Mich.

Elise LaChance, secretary, Chicago.

C. R. Knowles, treasurer, supt. w.s., I.C. (retired), Chicago.

F. E. Weise, treasurer emeritus, ch. clerk, engineering dept., C.M. St. P.&P. (retired), Chicago.

Directors

W. F. Martens, gen. fore. b.&b.&w.s., A.T.&S.F., San Bernardino, Cal.

A. L. McCloy, supv. b.&b., P.M., Saginaw, Mich.

L. C. Winkelhaus, arch. engr., C.&N.W., C.St. P.M.&O., Chicago.

E. H. Barnhart, div. engr., B.&O., Garrett, Ind.

A. B. Chapman, br. engr., C.M.St.P.&P., Chicago.

L. E. Peyser, prin. asst. arch., S.P., San Francisco, Cal.

G. S. Crites, ex officio, div. engr. B.&O., Baltimore, Md.

Officers Hold Post-War Meeting

J. L. Varker
President

Spirit of confidence prevails at busy one-day session at Chicago—Plans laid for simultaneous three-day convention with Roadmasters next year

R. E. Caudle
First Vice-President

Neal D. Howard
Second Vice-President

F. G. Campbell
Third Vice-President

J. S. Hancock
Fourth Vice-President

C. R. Knowles
Treasurer

entation and discussion of eight reports by technical committees, the election of officers for the coming year, the selection of eight new subjects for study by technical committees, the annual reports of the secretary and treasurer, brief addresses by the president and the president-elect, and the election of three honorary members.

The meeting was presided over by J. L. Varker, supervisor of bridges and buildings, Delaware & Hudson, Carbondale, Pa. Because an election of officers was not held at the one-day meeting in 1944, Mr. Varker appeared before the group for the second time in the capacity of president. In his address, delivered at the opening of the morning session, Mr. Varker first reviewed the accomplishments of the railroads during the war years and then touched briefly on the problems of the future, especially as they are likely to have an influence on the work and responsibilities of the bridge and building forces.

"We in the bridge and building departments," he said, "have a responsibility that is unique in that we have such a wide and varied list of properties to be maintained. It is to us that management looks for keeping up our bridges, buildings and water service facilities. Public opinion is often influenced by the appearance of our stations, that is, by the facilities provided for their convenience and comfort. We must, therefore, make our stations attractive in appearance and provide them with modern facilities. Furthermore, many of our bridges need repair, strengthening and renewal. Also, many of our water service facilities must be enlarged and revamped. We can now give our attention to all of these things."

Mr. Varker then went on to review the work of the Executive committee during the past year, pointing out that five meetings had been held. Several special committees were appointed, he said, one of which was assigned the task of conducting a campaign to obtain new members. That this committee functioned with gratifying results is seen in the report of the secretary, presented later in the day, the details of which are given at another point in this article. Another special committee mentioned was one appointed to prepare a memoir on the late W. A. Rogers, who was president of the association in 1900-1901. "Mr. Rogers was one of our oldest members," said Mr. Varker, "and until his passing was our oldest living past-president."

Technical Reports

As soon as Mr. Varker had concluded his remarks the group turned its attention to reading and discussing the eight reports prepared by technical committees, a task that had to be kept to a more or less rigid schedule to insure that this work would be finished in time to permit attention to be given to other items of business. The committee reports presented dealt with the following subjects: The Maintenance of Wood Bridges and Trestles; Restoring Old Masonry by Grouting, Including Surface Protection Where Necessary; Piles, Pile Driving and Exploration; Economical Methods for the Maintenance of Impounding Reservoirs; New Developments in Interior Painting; The Influence of Maintenance Practices on the Development of Modern Enginehouses; The Use of

Highway Trucks in Bridge and Building Work; and The Elimination of Fire Hazards and the Maintenance of Fire Protective Equipment. All these reports are presented in full in the following pages, together with abstracts of the remarks made by those present during the discussion period that followed the reading of each report.

The election of three new honorary members in the association was only one of the many manifestations in evidence at the meeting that the members are proud of their organization. It was also an indication that the members are anxious to bestow the emoluments of honorary membership in their group on persons "who have attained acknowledged eminence in some branch of engineering or railway service," to quote the constitution. The newly-elected honorary members are Ralph Budd, president, Burlington Lines, and a member of the association since 1927; F. L. Thompson, vice-president (retired), Illinois Central, who has been a member for nearly 40 years; and C. E. Johnston, chairman, Western Association of Railway Executives, who joined the association in 1911.

Plans for Next Year

With reference to the 1946 convention, a plan was proposed and adopted which contemplates a considerable departure from the policy followed in the past. The essence of this plan is to advance the date of the 1946 meeting one month so that it will coincide with that of the annual convention of the Roadmasters' and Maintenance of Way Association, to be held on September 17-19, 1946, at the Hotel Stevens, Chicago, that is, the two meetings will be held concurrently in the same hotel, although in widely-separated assembly rooms. As part of the plan the meetings will be supported by a joint exhibit of materials and equipment by member companies of the Track Supply Association and the Bridge and Building Supply Men's Association, which exhibit gives promise of being the largest and most comprehensive ever to be presented by either of these two groups at previous conventions of the Roadmasters' Association and the Railway Bridge and Building Association.

In the election of officers Neal D. Howard, editor, *Railway Engineering and Maintenance,* Chicago, was advanced from second vice-president to president (R. E. Caudle, principal assistant engineer, Missouri Pacific Lines, Houston, Tex., having resigned as first vice-president); F. G. Campbell, assistant chief engineer, Elgin, Joliet & Eastern, Joliet, Ill., was advanced from third vice-president to first vice-president; J. S. Hancock, bridge engineer, Detroit, Toledo & Ironton, Dearborn, Mich., was elevated from fourth vice-president to second vice-president; E. H. Barnhart, division engineer, Baltimore & Ohio, Garrett, Ind., a director of the association, was elected third vice-president; W. F. Martens, general foreman bridges, buildings and water service, Atchison, Topeka & Santa Fe, San Bernardino, Cal., also a director, was elected fourth vice-president; C. R. Knowles, superintendent water service (retired), Illinois Central, Chicago, was re-elected treasurer; and Elise LaChance was re-elected secretary. F. E. Wiese, chief clerk (retired), engineering department, Chicago, Milwaukee, St. Paul & Pacific, remains as treasurer emeritus.

Directors

Three directors were elected with terms expiring in 1946, these being A. B. Chapman, bridge engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago (re-elected); W. A. Huckstep, general building supervisor, Missouri Pacific, St. Louis, Mo.; and F. R. Spofford, assistant division engineer, Boston & Maine, Dover, N.H. Directors elected with terms expiring in 1947 included Guy E. Martin, superintendent water service, Illinois Central, Chicago; B. R. Meyers, office engineer, Chicago & North Western, Chicago; and L. E. Peyser, principal assistant architect, Southern Pacific, San Francisco, Cal. (re-elected).

In accepting the position and responsibilities of president of the association, Mr. Howard spoke in part as follows:

"Our association has just come through difficult times. War, with the necessary cancellation of our annual meetings, has put a heavy strain on our organization in spite of the loyal and untiring efforts of your president and other officers and directors. And it is to the everlasting credit of our association that we have carried on during the last three years—have put out such creditable technical reports each year and in that way have done our share as an association to help the railways carry through so successfully during the war period.

"Now we face a new period—a new era—an era in which the problems of bridge and building men—the opportunities for bridge and building men—may well be greater than ever before. How will we meet the challenge of this new era? To meet it successfully we must do certain things.

"We must first put our own house in order to the extent that it may not now be in order. We must revive interest among our members where that interest may have waned. We must make our members from distant parts of the country feel as intimately a part of this association as those within easy reach of our convention city. We must enlist a large number of new members and associate members and make their membership so worthwhile that they will soon be numbered among our most valuable members. We must impress anew upon railway management and higher engineering and maintenance officers the great value of our association to the railroads in the solution of their bridge, building and water service problems in the most effective and economical manner. We must impress upon them the value of attendance at our annual meetings and urge on them a schedule on their roads that will permit their men to attend these meetings."

New Subjects

As part of the planning for the year ahead, those at the meeting took time to consider and adopt the report of a committee that had been selected several months earlier to make recommendations regarding subjects for study during the coming year. An interesting sidelight on the work of this committee, and at the same time a measure of the degree of interest which its members took in their work, is the fact that it received approximately 50 suggested subjects for study, largely from its own members. From these the following eight subjects were chosen for investigation: Cause and Prevention of Personal Injuries to Bridge and Building Employees; Tools and Equipment for Bridge and Building Shops; Methods of Cleaning Water Lines, Sewers and Drains; Adapting Turntables to Meet Modern Conditions; Servicing Facilities for Diesel Locomotives; Methods of Improving Strength, Durability and Wear Resistance of Concrete; Utility and Economy of Pre-fabricated Buildings; and Developments in the Use of Off-Track Work Equipment.

The annual report of the secretary, Miss Elise LaChance, developed the fact that the association had acquired 43 new active members since October 1, 1944, raising the number of members in this category to a total of 430. During the same period 13 new associate members joined the association, with the result that there are now a total of 29 members in this category. Including all classes of membership the association now has a total of 553 members on its rolls.

Restoring Old Masonry by Grouting, Including Surface Protection Where Necessary

Committee Report

A. R. Harris
Chairman

THE idea of repairing masonry structures by pumping grout into their cracks and voids was conceived many years ago. As far back as 1909 an article appeared in the Engineering News-Record entitled "Pumping of Grout into Masonry on the Metropolitan Railway, Paris," and within the last 15 years, engineering publications have frequently contained descriptions of repairs to dams, tunnels, foundations and railroad roadbed. However, within recent years, specialists in the field of pressure grouting old masonry structures have made great progress in the selection of grouting materials having desirable characteristics, and in the technic of applying the grouting mixture.

Is pressure grouting as done today successful in giving new life to old structures, and how can one differentiate between structures that can be saved by grouting and those that must be replaced within the near future? What materials must be used for grout, and what procedure must be followed for grouting in order that all cracks and voids will be filled without shrinkage? These considerations have guided the compiling of this report.

Structures Suitable for Grouting

Many bridge piers and abutments, arches, retaining walls, box culverts and tunnels are in such poor condition that either adequate repairs must be made or replacement undertaken. Some stone masonry structures 75 years old are still in fair condition, but there are a great many not more than 40 years old where the mortar of the joints has lost its life, or where the action of high water, ice and floods has weakened them to such an extent that the individual stones are cracked, due to uneven bearing or movement of the stones. Where the foundations are adequate and the masonry is of fair quality, the life of these structures can be extended by pressure grouting and by restoring the surfaces to good condition for weathering. Most of the structures more than 50 years old are of stone masonry, although the footings of such structures are frequently of natural cement concrete. Brickwork is occasionally encountered in tunnels and arches. Most structures less than 40 years of age are of portland cement concrete construction.

A careful field inspection should be made before a decision is made to pressure grout an old masonry structure. The condition of the foundation should receive the first consideration. If such visible signs of settlement or instability as pumping at the ground line are observed, or if there is opening up of the joints under the movement of trains, the foundation should be exposed to determine what is actually taking place. Old stone masonry abutments and piers are frequently found to be supported directly on timber grillages, either with or without foundation piles. Where the foundation includes timberwork, the plane of permanent moisture should be ascertained. If this plane is below the timberwork, or if there is reason to believe that it will be lower in the near future, it is doubtful whether a very large expenditure for repairing the neat work will be warranted. In this connection, a point to keep in mind is the possibility of public authorities constructing drainage ditches that may have the effect of causing the channel to cut deeper.

The timberwork should also be examined for evidence of overloading from live loads, by observing whether there is any appreciable compression in the grillage during the movement of trains. It should also be noted whether there are any voids around the tops of piles that can be filled with grout. Where the supporting material beneath the foundation consists of gravel, stone or sand, a certain amount of grout can be forced into the voids of the bearing material, but where extensive pressure grouting is necessary, the grout will break to the surface just beyond the footing unless the foundation is confined by a cofferdam or other means.

After the foundation has been determined to be in good condition or that it can be repaired at reasonable expense, the neat work should be carefully examined as to quality of stone, general condition, horizontal and vertical cracks, laminations, slicing and surface disintegration. Where individual stones show pronounced surface disintegration, it should be noted whether there is evidence of water seeping through the masonry that may require the removal of certain stones and their replacement with concrete. If the stone masonry throughout is of poor quality, and scarcely able to carry the heavier applied loads of today without crushing, the expense of pressure grouting will not be warranted.

Pressure Grouting

The term pressure grouting is used to denote the scheme of forcing fluid grout into cracks, voids and cavities by means of pressure where direct depositing is not feasible. Pressure grouting is used not only to solidify old structures, but also as one means of placing concrete, in which case the coarse aggregate is deposited in place, and the grout is then forced under pressure into the interstices between the stones, in order to avoid the shrinkage of concrete placed in the ordinary manner.

Neat grout of cement and water will not flow freely into holes smaller than about three times the largest cement particles which, based on the 0.0028-in. opening in the 200-mesh sieve, would be 0.0084 in. This limitation applies to other finely pulverized materials and sand. Except in the case of large cavities where thick mortar or concrete can be placed, the sand or other materials

should all pass the 28-mesh sieve. Coarser particles will settle out of suspension and readily lose their coating of cement paste. Cracks smaller than 0.01 in. can be penetrated only by using a base of finely ground cement. A large amount of research work has been done on the possibilities of obliterating surface cracks in concrete of monumental structures and reports of experiments along these lines indicate that cracks as small as 0.002 in. can be permeated by using 1 part minus 40 micron fraction of cement to one part of water.

Desirable Properties of Grout

Although the term grout as ordinarily defined means a mixture of cement and water, or of cement, sand and water, there is much recent evidence to indicate that desirable properties may be imparted to the grout by incorporating special admixtures. For effective grouting the materials contained in the grout are of the utmost importance. An ideal grout would do the following:

(1) Flow through small passageways without plugging.

(2) Flow through small pasageways without large frictional resistance.

(3) Maintain the solid portions in suspension without separation or agglomeration of solid particles during the ordinary operations of grouting.

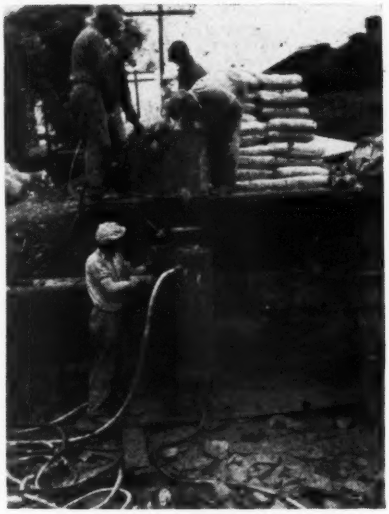
(4) Maintain the solids in suspension, without appreciable settlement, in a cavity filled with fresh grout, and hence without appreciable water gain until the grout has set, and subsequently harden without appreciable shrinkage, so that the cavity will remain completely filled with the hardened grout.

(5) Remain at substantially the same degree of fluidity for an appreciable period, say an hour or more, after the first addition of water to the mixture.

(6) Bond with the surrounding concrete and provide strength comparable to that of the surrounding concrete.

Quite a few engineers still believe that a satisfactory mixture of grout can be made with cement, fine clean sharp sand and water, and have carried out a large volume of pressure grouting work using such a mixture. For example, a typical specification permitted a mixture with proportions between 1 cement to 0.5 cement to 1 sand, and with a constant water-cement ratio of 1. For grouting stone masonry ordinary cement is used. Where fine cavities must be permeated, as in porous concrete below horizontal construction joints, finely-ground cement and water, without sand, will be required.

To impart a lubricating property to the grout, admixtures of various types are specified, such as (1) an oily Stearate compound, (2) a compound to impart to the slurry the properties of a colloidal suspension, and (3) a compound for dispersion of the cement particles.



A Grouting Set-Up Showing the Mixing and Pressure Tanks

Where it is not desired to incorporate a special admixture for obtaining lubricating properties, an air-entraining type of cement might be used, such as (1) a portland cement containing a special proprietary compound ground in at the mill, or (2) one consisting of a mixture of natural and portland cements.

To delay the setting-up, admixtures of diatomaceous earth or fine clay are sometimes used, or the sand may be dispensed with altogether, and a finely divided mineral may be used which has hydraulic binding and cementing properties when incorporated with portland cement. On the other hand, there may be situations where traffic conditions warrant the use of a compound for accelerating the setting-up of the grout. One such compound is sodium carbonate, used in the proportion of ½ lb. to a bag of cement. Where mass shrinkage of grout is a factor, compounds of an iron type have been added to neutralize the tendency of the grout to shrink upon setting.

As examples of work where special grouting mixtures were used, the following are mentioned.

(1) On one mid-western railroad, where many stone masonry structures and a few brick arches have been pressure grouted under contract within the last three years, the grout consisted of (1) ordinary portland cement, (2) fine mineral filler, (3) lubricant for grouting cracks or lubricant for grouting deposited coarse aggregate, and (4) water.

(2) On an eastern railroad the grouting mixture consisted of (1) ordinary portland cement, (2) sand, (3) a small amount of dispersing agent, and (4) water.

(3) On another mid-western railroad the specifications for pressure grouting included the incorporation of an iron compound with a cement-sand-water mixture where large cavities were to be filled with grout.

In all of these examples of actual work done by contract, the railroad engineers supervising the work have indicated their satisfaction with the finished work.

Pressure Equipment

The various methods of pressure grouting masonry structures rely on (1) gravity, (2) pneumatic pressure, or (3) pump pressure, to obtain suitable permeation. The pressure should be steady to insure a continuous flow of grout. Usually pressures from 25 lb. to 100 lb. per sq. in. will suffice, and it is rarely necessary to use pressures above 200 lb. per sq. in. However, where it is desired to force extremely fine neat cement grout into minute cracks in concrete, pressures up to 350 lb. per sq. in. may be required.

The gravity method may be used where the grouting equipment is located sufficiently above the point of application to give the necessary pressure, but does not lend itself readily to a wide range of pressures.

The pneumatic pressure method has been used, but is subject to hazards and uncertainties. With this method, it is important to cut the supply of air as soon as grout flow ceases. Unless extreme care is used in the pneumatic pressure method, air is apt to be forced into the seams if the grout flows faster than expected. Furthermore, the cement in a thin mix may settle to the bottom and plug the outlet, the pipe line, or the hole before the job is completed.

The most satisfactory equipment for pressure grouting is a pump of the double-acting flexible reciprocating type. This gives a steady flow, which is more effective in fine seams than the intermittent flow produced by pneumatic pressure, and the operator has a more even control of the pressure. The pump should be especially fitted for grouting work. The cylinders should have renewable liners that can be conveniently replaced. Equipment manufacturers are building pressure grouting pumps which greatly simplify the amount of equipment to be moved from place to place, and no doubt will continue to increase the efficiency of these machines. One quotation from a pump company

describes a size 6 by 2½ by 7 horizontal piston-type grout pump, to operate on steam or air, and guaranteed for 250 lb. pressure and 600 lb. liquid end pressure. Weight 440 lb.; price approximately $300. No doubt other sizes of this pump can be obtained.

Mixing Equipment

Special power-driven mixers are desirable, although a small concrete mixer with the clearances back of the mixing blades closed, and with splash plates fixed at the discharge chute, may be used. It is desirable that the mixer discharge through a screen into a tank equipped with an agitator. Mixing may be done by hand, but if done in this manner it is important to arrange to have a continuous supply of grout available instead of intermittently.

The most economical use of grout is obtained by a piping system that provides two lines to a hole; one carries the grout from the pump, and the second is a return line discharging into the tank. Since with this arrangement the grout is constantly circulated through the feed line and back to the pump through the return, any tendency to plug the supply pipe is eliminated. Where a single line is used for delivery, a blow-off near the discharge end of the line is useful to prevent plugging, and to clear out the line when desired.

Grouting Procedure

When pressure grouting, holes are drilled in the old masonry, a suitable size being 1½ in. These holes should usually be drilled at 90 deg. to the face, although for grouting footings they may be drilled at 45 deg. or other angle to the face. Where it is believed a blanket of grout is desirable at the back of a wall or arch to prevent the seepage of water, the holes should be drilled entirely through the wall. In such cases, careful watch should be maintained when grouting to see that large quantities of grout are not wasted.

In some cases, holes drilled vertically from top to bottom of a wall or pier, even penetrating the foundation, may be desirable. Where this is the case, a pipe smaller than the drilled holes, having a short section of flexible hose ("packer") near the end, is inserted nearly to the bottoms of the holes and then, progressively, the pipe, with the packer is pulled up as grouting is completed at various levels. The grout pressure causes the packer to swell and confines the grout flow to the lower layers.

Where the operation is to solidify the interior of a structure, the holes should be drilled to within a short distance of the opposite face. Sealing or pointing joints should be deferred until after pressure grouting in order to supply vents for the water and air displaced as grouting progresses.

There appears to be a wide difference of opinion as to whether the order of grouting holes, from top to bottom, or vice versa, is of any consequence. If the air and water are allowed to escape, it is likely that the grouting will be effective whichever order is followed.

It is frequently advisable to pump clear water into the holes at the start of operations to wash out dirt and other fine material, as well as to form a guide for the proper consistency of the grout. However, there is good opinion that this procedure may not always be desirable, because the loose material will not be carried out of the structure, but will wash to the bottom where it will prevent the grout from filling all of the voids. A better method to employ where water flushing is desired is to pressure grout the base of the structure up to the ground line or above, and then allow at least 24 hours for the material to set before flushing out the wall. Others believe the structure should not be flushed or washed out at all because of this settlement of fine material to the base.

Practice on D.&H.

The following description of work done on one railroad is given here, not necessarily as representative of the best practice, but because it is one of the most complete descriptions in attention to detail that was made available to the committee.

In 1940 the Delaware & Hudson began a program of restoration of

B. & B. SECTION

its old stone masonry by grout penetration, most of the structures being 75 years old. In the majority of cases the stone was laid up as pitched-face, random ashlar masonry, although some of the older structures were quarry-faced, broken-range, squared-stone masonry. The arch culverts restored were of coursed rubble construction. In all cases the stone was sound and suitable for permeation work.

Since beginning its pressure grouting work, the D.&H. has completed work on 26 structures, involving 19,116 cu. yd. of masonry permeated. The quantity of cement used for permeating has been 39,444 bags, which made up about 1,876 cu. yd. of grout material, mixed approximately 1 to ½. The amount of voids ranged from 2.2 per cent to 17.8 per cent. The average voids in all of the structures amounted to 9.8 per cent.

The method of grouting used has been by pneumatic pressure. The materials—cement, sand and water—are mixed in an open tank. An air line in the bottom of this tank allows escaping air to keep the material agitated. This mixing tank may be large enough to hold about 2 cu. yd. of material, but in any case it should be large enough to permit maintaining a supply of grout sufficient to permit uninterrupted grouting operations. As the grout is mixed thoroughly, it is passed through a valve, first to a screen to remove any large particles or foreign materials, and then into a receiving tank, which may be a barrel or a tank of about the same capacity as the mixing tank. From here the grout is discharged, as desired, through a valve

Showing Grouting Pipes in Place in a Stone Abutment. Inclined Pipes Extend Into Footing

and pipe, into a pressure tank. The pressure tank, which holds about 30 gal. of grout, is connected at the top to the air pressure line. An outlet is provided in the bottom of this tank, to which is connected the pipe or hose for carrying the mixture to the grouting holes. The operation of the pressure tank is as follows:

The pressure tank is filled by means of a gravity line from the receiving tank. When filled, this line is closed by means of a valve. The air valve is then opened, which applies air pressure to the material within the tank, forcing it through the pipe or hose to the grouting hole in the structure.

Continuously throughout the pressure grouting period the material is mixed and forced into the structure. As each grouting hole is filled or the material rises within the structure and escapes from other holes, the holes are sealed tight. In some cases, a bad break may occur in the structure, through which considerable grout may escape if the grouting is continued. In such a case the break is sealed tight by caulking and, if necessary, the grouting is stopped for the day to allow the break to seal itself. In most cases calking with oakum will allow the work to continue.

The grouting materials used are portland cement, clean sharp sand and water, in the proportion of one part cement, one-half part sand, and just enough water to make the material flow freely. No special admixture or quick-setting cement is used in making the grout.

Joints Cleaned and Pointed

All joints of the structure are thoroughly cleaned by means of pneumatic chipping tools. This removes all of the old cement mortar and insures that the joints are properly cleaned to receive the new pointing. Where the structure is partially submerged in water, the joints are pointed with a special quick-setting material. In some cases where the water is deep, a diver is used to seal the joints to prevent the grout from escaping. As leaks appear, the quick-setting cement is applied, and in most cases they can be stopped sufficiently to permit the grouting to continue. However, occasionally it is necessary to stop the grouting long enough to allow the grout to set up and cause the leak to be sealed.

During the time the joints are being prepared, it is the usual practice to drill all of the grouting holes, beginning at the footing, if possible. At the footing the holes are inclined downward at about 45 deg., which insures that the grout reaches the bearing soil. If a timber mat is encountered under the structure, a few holes are drilled through the timber in order to fill any voids under it.

If the structure is made up of large stones, it has been the practice to drill grouting holes in each course of stone. Where the stones are of irregular

Stone Arch Before Repairs Were Made

size, the holes are spaced one for each 25 sq. ft. of surface. In all cases the holes at succeeding levels are staggered with those of the level immediately below. The advisability of drilling plenty of grouting holes cannot be stressed too strongly, as this is the only means of finding the voids in the structure.

In the case of masonry walls, all holes are drilled to the core of the wall and frequently the holes are drilled entirely through the wall for the purpose of determining its thickness and for grouting the fill behind it. Grouting holes should not be drilled entirely through the wall until after the structure has been completely pressure grouted, because the grouting material will flow to the place of least resistance, and if some of the holes are drilled completely through the wall, there is a possibility that the voids within the wall will not be filled. After the masonry structure itself has been completely grouted, then, if desired, grouting holes may be drilled entirely through the structure to permit grouting the material behind it.

Flush Out Interior

Following the drilling of the grouting holes, and before pointing, it has been the practice to force water under pressure into the interior of the structure to flush out the loose old mortar. When the joints have been prepared, and after flushing, if used, the joints are pointed with grout by means of a pressure gun. This method forces the grout well into the joints and, in most cases, prevents any leakage of the grout subsequently forced into the interior.

Grouting Procedure

After pointing of the joints, short sections of pipes, with a hose connection on one end, are inserted into the grouting holes. These pipes are about 18 in. long and 1¼ in. in diameter. The size of the pipe used depends on the size of the grouting holes drilled, but, as a rule, 1½-in. holes are drilled for this size pipe. The pipes are securely fastened into the holes by caulking with oakum or by grouting with cement mortar, allowing the mortar to set firmly before using the pipes. In any case the pipes must be sealed against leakage during the pressure grouting work. The caulking method works to the best advantage, because where this method is used it is not necessary to install the pipe nipples into all of the holes before starting the grouting.

As the grout is forced into the structure, starting at the lowest hole, it is possible to observe the gradual rise of the material throughout the entire structure by the appearance of moisture along the joint lines, or by grout escaping from other grouting holes, provided, of course, that the grouting holes are interconnected with the same voids. When the grout rises to about the level of the grouting hole being worked, this hole is sealed with a wood plug and the hose is connected to another grouting hole on the same level that has not already been plugged to prevent grout escaping, or to another grouting hole higher up on the face of the structure.

In the case of most of the structures grouted it was found that it was not necessary to use all of the test holes, and that three or four holes on the same level were sufficient to keep the grout rising uniformly throughout the structure. In the case of large structures, it is advisable to limit the amount of grout placed in any one hole, and then to move along the face to other holes. This will insure uniform grouting, and will also prevent the material from separating.

In the case of abutments having stepped wing walls it is the practice to drill grouting holes into the horizontal surface of about every third course. These holes are used to grout the top portions of the wings and serve to indicate when the wall is filled.

At the level of the bridge seat, vertical holes are drilled through which the grout is forced into the top course

of the body of the wall. Similar holes are drilled into the backwalls. In both cases the person operating the plant should exercise care that the coping or top backwall stones are not disturbed, because the pressure applied is great enough to raise these stones from their beds, and, if raised, they may not reseat themselves properly.

Recent inspections of the structures internally grouted on the D. & H. indicate that the permeating work has been successful in restoring the masonry to its former strength.

Surface Treatment

Where the surface of old masonry is subject to deterioration from frost action, or where good appearance is deemed to be a required characteristic, as in the case of structures readily seen by the public within urban areas, it is desirable to apply a surface coating of shot-crete, or to construct a concrete jacket in front of the surfaces which would otherwise be exposed. A coating of shot-crete 2 to 3 in. thick will usually be found to be more economical than a jacket of concrete, and because of its greater density, it will resist weathering better than concrete. In this connection it is appropriate to suggest the use of an air-entraining type of cement, or that an entraining agent be added if ordinary portland cement is used, in order to secure greater resistance to thawing and freezing.

To insure that worthwhile results will be accomplished by surface treatment, it cannot be emphasized too strongly that every precaution must be taken to secure an effective bond between the new surface material and the old masonry or concrete. To accomplish this it is necessary to remove thoroughly all loose material from the surface; also to remove all portions of stones where tapping with a hammer indicates vertical slicing of the front faces. The surface of all masonry or concrete should be thoroughly cleaned, the use of sand blasting being advisable. About an hour before placing the protection coat, the surface of the old masonry or concrete should be saturated with water.

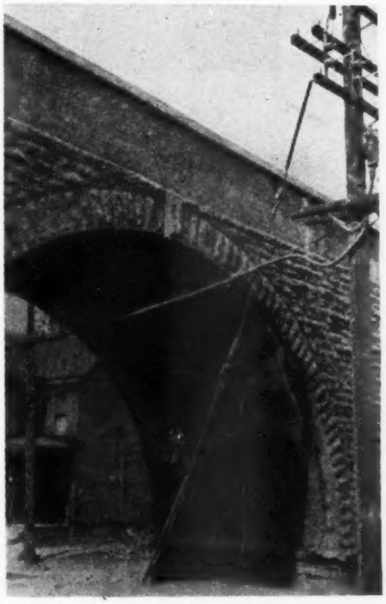
If the protection coat is to be concrete, the surface of the old masonry or concrete should be given a coating of cement and water. This is generally brushed on, but better bond will be obtained if this coating is applied by a pressure gun, to force the cement into the pores of old masonry stones or concrete. This may seem to be carrying precautions too far, but the lasting qualities of the surface protection will depend more on effective bond than on any other single factor.

A large volume of pressure grouting work, all of which appears to be satisfactory, has been done on the railroads within the last three or four years. Most of this work has been done by contractors specializing in this class of work. Whether the work is done by company forces or by contract, a careful inspection should be maintained at all times while the work is under way to see that the grout is actually reaching the cracks and cavities to be filled. The only way this can be determined with certainty is to drill out cores of grouted material for inspection.

In conclusion, it may be said that pressure grouting, as done by competent organizations today, is a very valuable and economical method of repairing masonry structures that would otherwise need to be replaced.

Committee Personnel

A. R. Harris (chairman), asst. engr. of br., C. & N. W., Chicago; J. S. Hancock (vice-chairman), br. engr., D. T. & I., Dearborn, Mich.; M. D. Carothers, ch. engr., Alton, Chicago; Armstrong Chinn, gen. mgr., Alton, Chicago; H. D. Curie, mast. carp., B. & O., Garrett, Ind.; Henry R. Dallery, supvr. b. & b., L. V., Jersey City, N.J.; Elmore J. DeWitt, engr. b. & b., N. Y. O. & W., Middletown, N.Y.; M. H. Dick, managing editor, *Ry. Eng. & Maint.*, Chicago; Leo D. Garis, gen. br. insp., C. &



The Arch Shown on Opposite Page After Grouting and Shotcreting

N. W., Chicago; Robert W. Gilmore, gen. br. insp., B. & O., Cincinnati, Ohio; Paul Haines, asst. b. & supvr., P. M., Saginaw, Mich.; Jesse S. Hyatt, ch. engr., C. N. S. & M., Chicago; Harold W. Jenkins, b. & b. supvr., N. Y. N. H. & H., Boston, Mass.; Hans L. Larsen, str. iron fore., C. St. P. M. & O., St. Paul, Minn.; C. A. Lyon, field engr., Master Builders Co., Chicago; W. F. Martens, gen. fore. b. & b. and w. s, A. T. & S. F., San Bernardino, Cal.; E. C. Neville, Dur-ite Company, Toronto, Ont.; O. W. Stephens, asst. engr. str., D. & H., Albany, N.Y.; E. E. Tanner, gen. supvr. b. & b., N. Y. C., New York; and B. R. Wood, Master Builders Company, Cleveland, Ohio.

Discussion

W. A. Huckstep (M.P.) inquired about the use of bonding irons for insuring the adhesion of new concrete to the old surfaces, stating that he has had excellent results from their use, whereas prior to their use he had experienced considerable trouble in getting a satisfactory bond. Chairman Harris replied that a good bond can be obtained through the use of good mixtures of the concrete that is to be applied. In the course of the discussion C. A. Lyons (Master Builders Company) stated that he had used bonding irons with success in the restoration of floor slabs, and explained that the secret of the success in this regard is that the irons key the old and new surfaces together so that they maintain the intimate contact that is created when the new concrete is deposited against the old surface.

Methods Vary

G. E. Detzel (George E. Detzel Co.) emphasized that when attempting to bond new concrete to old concrete or stone surfaces, consideration must be given to the character of the old masonry. He explained that while it is customary to wet the old surface so that it will not draw the moisture from the newly mixed concrete, hard non-absorbent surfaces do not take up any of this slushing water and neither does the new concrete adhere to them. For this reason, he said, an artificial bond must be created by applying a coating of metallic compound and allowing it to dry. This film attaches itself firmly to the old surface and the new concrete does likewise with the film, creating a satisfactory bond which has the added advantage that it prevents shrinkage of the new concrete, which is so often the cause of faulty bond. On the other hand, he stated, all that is needed to insure a satisfactory bond with a soft absorbent surface is to slush it suf-

ficiently so that it will not bleed the water from the new concrete.

In this connection, A. B. Chapman (C.M.St.P.&P.) stated that in his experience it was important that the surface to be built up be clean and that, if it was then well slushed, a good bond could be obtained between the two surfaces.

L. C. Winkelhaus (C.&N.W.) inquired whether, when pressure grouting old masonry, it is not desirable to flush out the interior with clear water before the grout is introduced to insure clean surfaces to which the grout can adhere. Mr. Harris replied that there is a wide difference of opinion on this subject, and that there are many staunch advocates of the practice while there are fully as many who are opposed to this practice for various reasons.

Some discussion arose as to the relative advantages of straight pressure grouting and of grouting by the pneumatic method. W. R. Gilmore (B.&O.) stated that a considerable volume of grouting had been done under his supervision during recent years and that as a result of this experience he favors the straight pressure process rather than the pneumatic process.

The Use of Highway Trucks in Bridge and Building Work

Committee Report

THE assignment of this committee covers a comparatively new development in bridge and building work, which has not reached its full development. In many cases only the first steps are being taken. This report, therefore, should be considered as comment on a continuing development in methods of handling bridge and building work.

In the present stage of development, the use of highway motor trucks in bridge and building work is a matter for study by each supervisor to determine just what is needed to meet his particular requirements. Therefore, no specific recommendations have been included in this report. For the same reasons, no attempt has been made to include a survey of present organizations and practices on various roads.

F. R. Spofford
Chairman

Past Practice

Until influenced by the highway motor truck, the conventional organization for bridge and building crews has been based on boarding-car outfits for major work, with small home crews traveling by train or track motor car to handle their more restricted work. Boarding-car crews were originally equipped with hand cars. These have been superseded by track motor cars, with trailer cars for handling some materials.

In its essential features, such a crew was organized to work entirely from the track. Men were moved from place to place by work train or track motor car. Materials were handled by work train or track trailer car, or by locomotive crane or derrick car. All of the heavy equipment was track mounted.

This practice was, to be sure, more economical than earlier practices or methods of doing work before track-mounted equipment reached full development. However, the disadvantages of on-track methods have become more and more apparent in recent years.

In the first place, in almost all cases where heavy rail equipment is used, operating department crews are required for protection. In addition to adding materially to the expense of carrying out work, such equipment has frequently caused serious delays to work when operating crews could not be obtained readily.

A further distinct disadvantage lies in the limited time such equipment can occupy tracks during periods of heavy traffic, and another is that it requires, in many cases, the provision of expensive spur tracks and other facilities adjacent to the work location. As for the practice of transporting men to and from work on passenger trains, the general tendency in the past few years to curtail local passenger service and to eliminate many branch lines, has made this practice increasingly difficult, and in many cases impossible.

Use of Trucks

In an attempt to meet these disadvantages the use of highway trucks was introduced on a small scale. Ordinarily, a few trucks were first assigned to home crews to enable them to cover their territories independent of train operation and services. These crews were frequently special crews, such as plumbers, painters, etc., and supplying them with trucks was intended to meet specific needs. Such assignment and use of trucks was found particularly advantageous in terminal locations, and as these advantages were realized, more trucks were added, resulting in the elimination of many boarding-car outfits.

There are limitations in the use of highway trucks, but these are being reduced as their use is being extended to more and more types of work. There are certain operations, such as heavy bridge erection, pile driving, etc., which are essentially on-track operations. However, with new developments in off-track equipment, which will become generally available after the war, it is probable that this phase of bridge and building work will undergo some change.

At Terminals

The use of highway motor trucks by the bridge and building department forces is now widespread, and on roads where they are already being employed, their use is being extended. Railroads which have not used them in the past are, in many cases, beginning to use them.

A discussion of the present use of highway motor trucks by the bridge

and building forces may well be divided between terminal and line operations. Terminal operations are, in general, characterized by a heavy concentration of facilities requiring constant maintenance. In addition, there is frequently a large amount of commuting passenger traffic involved, with heavy train movements to the terminal in the morning and away from it at night. These conditions, calling for large bridge and building forces on the one hand, and involving considerable difficulty in operating equipment on track and in moving men by regular passenger train for minor repair work, on the other hand, are particularly advantageous for the use of highway motor trucks.

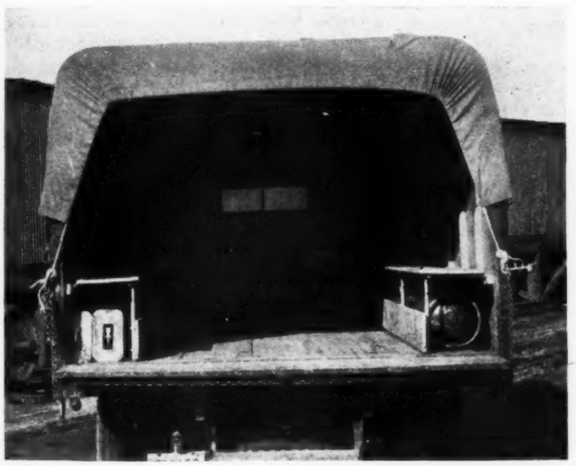
In a well developed terminal highway motor truck organization all trucks are ordinarily pooled, and are dispatched by one man under the general supervision of the bridge and building supervisor. This results in the most intense use of all equipment.

Types of Trucks

The types of equipment ordinarily assigned to terminal use are:

(1) Heavy Stake-Body Trucks—One or two of these to a division will ordinarily handle all heavy material. It is usually more economical to rent equipment for moving very heavy material, rather than to own equipment not required at all times and not economical to operate for medium or light loads.

(2) Medium Stake-Body Trucks—These are ordinarily equipped with



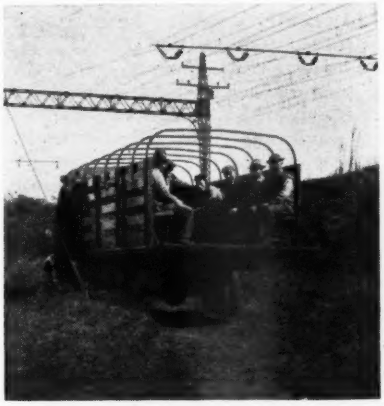
Medium Stake-Body Trucks Are Well-Suited to the Requirements of Carpenter Crews

canvas hoods or bows, and with folding or removable seats. They are well suited to the requirements of carpenter crews in bridge and building repair work. A large number of men can be transported, and with seats removed or folded back, material can be carried for the work of the crews.

(3) Light Stake-Body Trucks — These are ordinarily used by small carpenter repair crews, and by painters, tinsmiths, water service repairmen, etc. They are generally preferable to panel-body trucks, since considerable material can be carried in them in addition to a number of men.

(4) Panel-Body Trucks — These are in use in many places, generally for special crews, such as painters, tinsmiths, water service repairmen, etc.

(5) Special-Body Trucks—These



Example of a Heavy Stake-Body Truck in Railroad Service

are not required ordinarily in terminal operation. The advantages of such trucks, fitted up for use by special crews, are generally outweighed by the advantages of being able to make more intensive use of general-purpose trucks. Dump trucks, provided with removable seats and canvas hood, are of considerable value for mason crews. With such trucks it is possible to handle aggregates for concrete work or bituminous concrete for station platforms.

Line operations are, in general, characterized by a wide dispersal of

B. & B. SECTION

the facilities to be maintained. Home crews, located at various widely separated points, can take care of the light repair and maintenance of these facilities, but boarding car crews are more generally used for heavy repairs. Under these conditions, centralized control of trucks is difficult, and, ordinarily, trucks are assigned to specific crews.

The types of highway motor truck equipment generally assigned to line operations are as follows:

(1) Heavy Stake-Body Trucks—Due to the long distances men and materials must be transported, these are generally not desirable because of their slower speed. For special jobs where heavy trucks are needed, it is generally preferable to rent them.

(2) Medium Stake-Body Trucks—This type of truck is that most generally used by carpenter crews. Because of the longer trips to be made, it is generally necessary to make special provision for the protection of employees against the weather. This is particularly true in the winter in the northern part of the country. This may be done by providing a second cab or by providing a small enclosed and heated cab which can be removed when the full area or capacity of the truck is required for moving material.

(3) Light Stake-Body Trucks—These are not as desirable for line operations as for terminal operations. After provision for sheltering employees is made, the space available for material and equipment is limited.

(4) Panel - Body Trucks — These can be used to much greater advantage in line operations than in terminal operations. The enclosed body gives adequate shelter for employees, and heaters are required only in the most severe climate. When provided with racks for ladders, pipe or other long equipment, they can be used effectively by painters, water service repairmen, and small carpenter crews.

(5) Special Body Trucks — This type of equipment has considerable advantage in line operations. Since trucks in these operations are assigned to specific crews, it is possible to fit them up for a specific purpose. An example of this use is that of panel-body trucks for painters, with ladder racks, lockers for paint and brushes, etc. Similar trucks are being used by water service repairmen, with provision for tools, fittings, etc. At times, these trucks are equipped with a second cab for employees.

The equipment described for line operations is ordinarily assigned to

home crews. This permits them to cover a larger area than would be possible travelling by passenger train or motor car. Considerable economies in man-power are also obtained.

The work of boarding-car crews can, in many cases, be made more effective by assigning trucks to these crews, as needed. These trucks are used for transporting both men and materials as circumstances require. Such trucks may be company-owned or rented for the occasion.

Special Equipment

In connection with the use of highway motor trucks, two cases of the use of special equipment are of interest. One large eastern railroad has several highway motor trucks equipped with flanged guide wheels, which permit the trucks to be operated on the tracks. These trucks have been found to be particularly advantageous in bridge inspection and light repair work. Their use makes it possible to travel from point to point by highway and then reach the bridge by rail from the nearest highway. General use of such equipment would probably call for careful consideration of the possible requirement that they be operated by train crews.

On a large western railroad, where there are long distances between stations, painting crews are provided with panel trucks for ladders and equipment, and a highway trailer for living quarters. This combines the advantages of highway transportation with the boarding car advantages of housing the men at or near their work. It seems that the use of such outfits may become more general.

Off-Track Equipment

It should be realized that the use of highway motor trucks is only one phase of the effort being made to avoid the disadvantages of operations from the track. Considerable study has been given to the general subject of off-track equipment, and this should be carried along with the use and further study of highway motor trucks.

As bridge and building crews are equipped with highway motor trucks, their other equipment should keep pace. Track-mounted compressors should be replaced with trailer-mounted compressors. In many cases air tools and compressors should be replaced by electric tools and portable electric generators. These can be carried by truck over the highways and then readily carried by hand from a railroad crossing to the job.

Highway truck-mounted cranes can be used to advantage for many jobs. In the case of work on an overhead highway bridge, it is ordinarily much more economical to transport men and material by motor truck and to erect the material with a truck-mounted crane, than to use a work train and locomotive crane.

Conclusions

It is apparent from the general experience of the members of this committee that highway motor trucks are of great benefit in bridge and building operations. We do not feel at this time, however, that any specific organization can be recommended. Conditions vary so widely from railroad to railroad, and even from division to division of the same railroad, that an individual study of the particular conditions involved is necessary in each case.

Considerable savings in money and in manpower can be made by properly equipping crews with trucks. These are increased when trucks are supplemented by proper off-track equipment.

Attempts should not be made to do all work by highway truck and off-track equipment. Rather, careful study should be made to establish for each situation the best method of operation.

The application of highway trucks to the bridge and building department should preferably be gradual, with careful study as each forward step is made. In this way the purchase of unsatisfactory equipment may be avoided and the maximum use of the equipment obtained.

We feel that more and more use of highway trucks and accompanying off-track equipment should be made.

Panel-Body Trucks Provide Adequate Shelter for Employees

Committee Personnel

F. R. Spofford (chairman), asst. div. engr., B. & M., Dover, N. H.; H. F. Bird (vice-chairman), supvr. b. & b., N.Y.C., Syracuse, N. Y.; F. G. Campbell (vice-chairman), asst. ch. engr., E.J. & E., Joliet, Ill.; H. C. Crawford (vice-chairman), supvr. b & b., S. P., Dunsmuir, Cal.; E. H. Barnhart, div. engr., B. & O., Garrett, Ind.; W. H. Begeman, asst. supvr. b. & b., M. P., Falls City, Neb.; H. F. Bennett, mast. carp., Erie, Dunmore, Pa.; H. R. Herrick, asst. supvr. b. & b., S.P., Bakersfield, Cal.; N. D. Howard, editor, *Railway Engineering and Maintenance*, Chicago; W. A. Hutcheson, supvr. b. & b., C. & O., Clifton Forge, Va.; W. G. Kemmerer, asst. engr. b. & b., Penna., New York; P. L. Koehler, asst. supt., C. & O., Peach Creek, W. Va.; A. L. McCloy, b. & b. supvr., P.M., Saginaw, Mich.; W. K. Manning, supvr. b. & b., Erie, Cleveland, Ohio; E. W. Moore, mast. carp., C.B.&Q., Centerville, Ia.; C. E. Russell, supvr. w. s., I.C., Chicago; S. R. Thurman, asst. supvr. b. & b., M. P., Nevada, Mo.; E. E. R. Tratman, civil engr., Wheaton, Ill.; J. S. Vreeland, eastern editor, *Railway Engineering and Maintenance*, New York.

Discussion

C. Miles Burpee (Ry. Engr. & Maint. Cycl.) raised a question regarding the economical distance that a truck handling supplies and materials can operate from its home terminal. Chairman Spofford replied that his experience has been that at large terminals trucks can be operated economically for distances between 35 and 50 miles, and that for special work out on the line, such as water service repairs, they can be operated economically up to distances of 100 miles from headquarters.

Leo D. Garis (C. & N. W.) asked if the use of trucks has done away with boarding car outfits. In answer to this question Chairman Spofford said that on his division of the Boston & Maine the outfit cars in use by terminal crews had been reduced from six to one, the latter being maintained for special purposes. He added that the elimination of outfit cars has made it possible to obtain a better class of workmen.

W. A. Huckstep (M. P.) mentioned that the more extensive use of highway trucks for transporting men has had the effect of reducing motor

car accidents. Mr. Huckstep also pointed out that the use of trucks saves considerable traveling time for crews, especially around terminals. B. H. Goodwin (Sou.) stated that at one point on his road a crew using a truck equipped with a power winch was estimated in one year to have saved an amount of traveling time which would be equivalent to the working time of a second gang of equal size for a period of six months.

A. L. McCloy (P. M.) stated that on the Pere Marquette the regular bridge gangs on each division are housed in camp cars, but that emergency work is handled by truck crews operating as far as 130 miles away from the home terminal.

Answering a question raised by R. E. Dove (Ry. Engr. & Maint. Cycl.), Mr. Spofford said that on his road trucks in use at terminals are usually maintained and repaired by company forces, but that out on the line the company has contracts with local garages for handling this work.

B. & B. SECTION

The Influence of Maintenance Practices on the Development of Modern Enginehouses

Committee Report

ENGINEHOUSES were among the first buildings constructed by the railroads, and were originally used simply as a shelter for locomotives at the ends of their runs. Very little servicing of the locomotives was anticipated at that time, and the type of construction employed was commensurate with the proposed use of the facility.

As time went on, it was found necessary and economical to perform more work on locomotives standing in the house, and, within recent years, self-propelled cranes and trucks and other portable equipment have come into use, requiring better floors, better lighting and other improvements to meet expanding needs and to expedite the handling and servicing of motive power.

To bring about these improved conditions and to make necessary repairs and alterations, the bridge and building forces of the railroads have been called upon again and again. This work over the years has served as a guide in the design of the present modern enginehouse. It is the purpose of this report to consider not only the various details of construction of enginehouses, but also the various types of alterations and improvements that have been made, which have aided in the development of modern enginehouse construction.

L. C. Winkelhaus
Chairman

Foundations

Most of the early enginehouses were constructed of wood on timber foundations and were more or less of a temporary character to expedite construction. This type of construction was invariably followed on new lines, with the idea of building more permanent structures when rail transportation became established. However, many of these so called "temporary" enginehouses are still in use after many years of service.

The foundations of such structures consisted of untreated pile stubs or posts, which were readily available on new construction. These were capped with a timber sill of ample size and the walls were constructed thereon.

When repairing such foundations it has frequently been the practice to replace the pile stubs or posts, and the timber sills, with creosoted material. In other instances it has been the practice to construct concrete piers, or footings, at the load-bearing points, and a concrete wall between such piers, thus eliminating all wooden construction in the foundations. When necessary to construct frame enginehouses, it would be well to consider this latter type of construction, bringing the top of the concrete walls to an elevation about six inches above the level of the enginehouse floor.

In the better class of earlier enginehouses, the foundations were made of rubble stone or concrete. In general, it was the practice to extend this masonry up to the window sill level, or about four feet above the floor level. Oftentimes a locomotive has been accidentally run through such a wall, not only causing considerable damage to the house, but to the locomotive as well. When making repairs, or rebuilding the section of wall damaged, the bridge and building forces have usually omitted the concrete or stonework between the floor level and the window sill, and have replaced it with brickwork. This led to the practice in new construction of stopping the concrete foundations at the floor level, or slightly above.

Outside Walls

As mentioned previously, many enginehouses were constructed of wood, the wall studs resting directly on the timber sills. In what was considered the better class of frame construction, common brick was laid up between the studs on the inside face of the wall. Usually two double-hung windows were provided in each stall, each about 4 ft. wide by 12 ft. high; the height being necessary to throw the natural light a maximum distance into the house.

In making repairs or alterations in such cases it has been the practice to provide an additional window in each stall, and usually a better type of window—sometimes with metal sash, and at other times with sash of treated wood. Since double-hung windows require considerable maintenance, sash with ventilating pivoted openings, which are easier to maintain and are more weather tight, have been frequently installed in enginehouses.

Similar conditions prevail in enginehouses constructed with solid masonry walls, and it has often been necessary to replace the sash and provide additional windows. While metal sash and windows of the newer types have been installed in many instances, it is becoming increasingly common to fill such window openings with glass blocks. Glass blocks are readily obtainable and can be secured in various designs and sizes. The size blocks used is immaterial, but their surface should be smooth. Since glass block are not load bearing, lintels must be used in the openings the same as for ordinary windows. In exceptionally high window openings steel sub-lintels are necessary. Of course, ventilating openings must be provided.

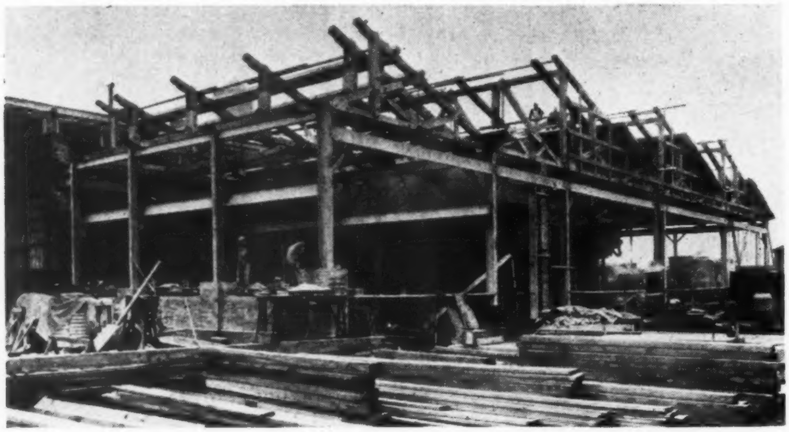
In modern enginehouse construction, the outer walls are of brick and glass, and extend from a few inches above the floor level to the roof structure. The piers, or pilasters, are usually three or four feet wide, and the walls between pilasters are of brick to window-sill height, and from this level to the roof line are of ordinary window construction, or glass block—preferably glass block. Such construction will give maximum natural light for the more exacting work to be performed in the enginehouse.

Roof Construction

Timber is still the prevailing type of roof construction for enginehouses. In many of the older houses, the roof purlins were supported from the girders by means of metal joist hangers, or metal stirrups, to bring the tops of the purlins even with the tops of the girders, and thus simplify the laying of the roof decking. When rebuilding such roofs, it is now the practice to place the purlins so they will bear on the tops of the main girders, thus eliminating the use of metal joist hangers or stirrups, which have always been a source of trouble.

Roof decking is usually dressed and matched lumber, or shiplap. When purlins are on six-foot centers or less, two-inch pine or fir is used, and is placed so that no end joints occur between supports. Whether material given a preservative treatment should be used in the deck is a matter for each individual railroad to decide. However, fire-resistive treatment of the timber should receive consideration.

Within recent years, pre-fabricated timber structures have come into the market. Such structures have been designed to secure the maximum structural use of the various members involved. All timbers are cut to the exact length, are prebored for bolts, and all bolts, nuts, timber connectors, etc., for erection, are furnished. Some railroads have made use of such construction with good results.



Enginehouse Roofs Are Still Predominantly of Wood Construction

Reducing Fire Hazard

Costly fires in enginehouses have directed attention to methods of reducing the fire hazard by the construction of roof curtain walls, and other related protective measures. One road in particular has undertaken an extensive program of installing fire curtains in those of its more important enginehouses which are largely of frame construction. Essentially, the method employed by this road is to divide the roofs of these structures into sections by the installation of fire curtains of asbestos-cement sheets under the ceiling at intervals of three or four stalls, and by enclosing the supporting timber columns under each curtain with the same material for their full height, and all other columns to a height of 12 ft. The fire curtains extend entirely across the structure from the inner to the outer circle walls. Such construction is not designed to furnish absolute fire protection, but is intended to localize a fire and delay its progress, giving the fire-fighting services an opportunity to bring it under control and prevent serious damage to other sections of the house and equipment.

Roofing

A great many enginehouses, and practically all of the older ones, have tar and gravel roofing. Such roofs have given good service and can be maintained readily by the bridge and building forces. In modern enginehouse construction, the designer has a variety of roofing materials to choose from, and in his choice he will, no doubt, be governed largely by the practice on his particular railroad. Obviously, the roofing should not be of such a class or quality that it will outlive the decking on which it is laid. For enginehouses, it would seem preferable that the surface should be covered with gravel embedded in a flood coat of tar, pitch or asphalt.

For the better class of roof construction, five-ply built-up roofing is used, while for ordinary construction, a four-ply roofing is ample. As to whether tarred felts, asphalt-impregnated rag felts, or asphalt-impregnated asbestos felts should be used is a matter to be decided upon by the individual road. If properly applied, each type will give good service.

Floors

The bridge and building forces have often been called upon to repair, replace or re-construct various types of floors in enginehouses. Plank floors laid on wooden sleepers were often used. Such floors require a large amount of maintenance and do not present a very good surface for trucking. Brick laid on a sand cushion proved very satisfactory until the advent of modern enginehouse servicing equipment and the more intensive use of enginehouses. Such floors become quite uneven from usage, become more or less slippery from oils and greases, and do not present a good surface for jacking purposes. Repairs have been made by leveling up the low spots, by applying an asphalt mastic surfacing, and by replacing certain portions with concrete.

Concrete floors have proved very satisfactory for enginehouse floors. Such floors are easy to keep clean and free from water, present a good

surface for walking and trucking, and require very little maintenance. Modern enginehouse design calls for concrete floors.

To insure a sound concrete floor, the foundation material on which the floor is laid should be sand or gravel, well compacted. The concrete should be not less than six inches thick, and should be reinforced with wire mesh or reinforcing bars. Between stalls, the floor areas should be pitched toward the engine pits so that water will not stand on them, the floor being level with the tops of the rails at the pits. The concrete should stop just short of the pit rails and the remaining space should be filled with an asphalt mastic, or a creosoted piece of timber. Weep holes should be provided under the pit rails to keep the openings along the rails free from water.

Engine Pits

Engine pits have been constructed of various materials. Many of the older pits were built of wood with plank floors. Some have been built of stone masonry with brick floors. Later practice has called for concrete pits with short wood ties embedded in the concrete walls for supporting and fastening the rails. It is modern practice to construct engine pits of concrete throughout, with the floor crowned and pitched to drain. Instead of using short ties to hold and fasten the rails, "U" bolts or a pair of straight bolts are embedded in the tops of the concrete side walls of the pit, usually on two-foot centers. A steel plate is provided at each set of bolts for rail bearing and to provide openings under the rails for the passage of any water that might enter between the rails and the adjacent floor. The pit rails are fastened with rail clips and nuts. Asphalt mastic or creosoted timber is placed between the pit rails and the adjacent floor alongside.

Pit walls need not be more than two feet thick. However, where necessary to provide for jacking operations, walls should be much thicker to provide bearing for the jacks. In some instances it may be advantageous to construct jacking pads entirely independent of the pit walls. Such jacking pads require heavy reinforcement and should be designed for the loads anticipated.

Enginehouse Doors

The large entrance doors of enginehouses probably require more maintenance than any other part of such houses. The type most commonly used is the ordinary swinging door, hinged at the top, middle and bottom to the adjacent door post. Clear horizontal door openings in the past have been approximately 13 ft. However, with the advent of larger locomotives, various organizations have advocated wider door openings, and the clearance laws of many states require horizontal clearances up to 8 ft. from the center line of the track.

It is almost impossible to maintain swinging doors 8 ft. wide and 17 ft. high. Fortunately, the clearance laws are not retroactive, and present door clearances may be maintained. However, in new construction, consideration must be given to a different type of door. Some roads have used a rolling shutter door, of either wood or

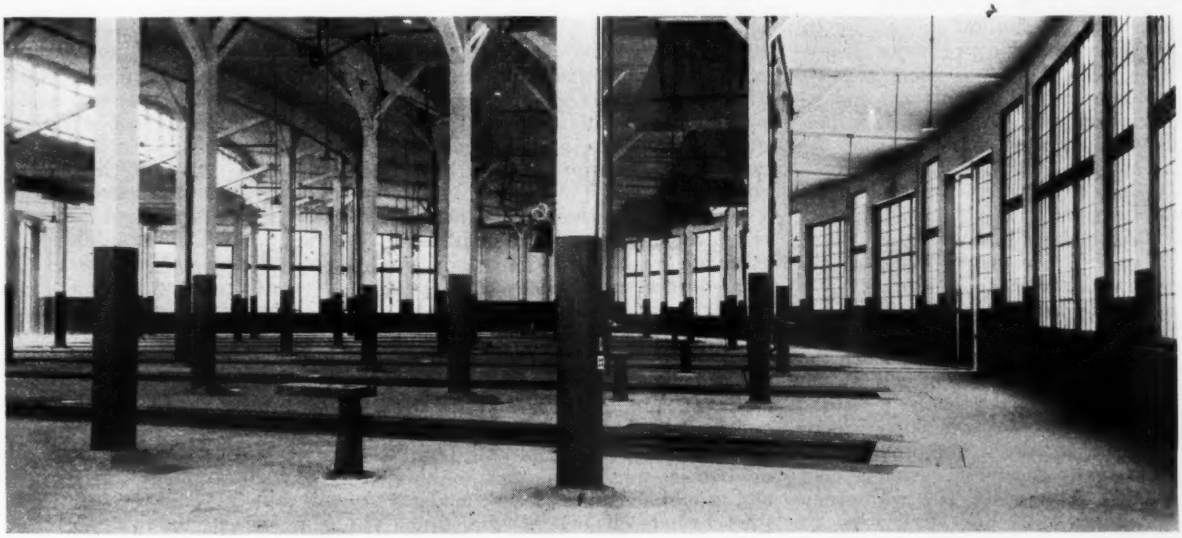
B. & B. SECTION

metal. In case of accident, such doors can hardly be repaired, so must be replaced. A sectional folding door, carried on overhead supports, seems to be the proper solution to a difficult problem, and such doors are coming into use more and more. Such doors should receive careful consideration in modern enginehouse construction.

Heating

The heating of enginehouses was originally accomplished in most instances by means of large pot-bellied stoves surmounted by a large cylindrical metal heat chamber. The more important enginehouses were heated by means of high-pressure steam pipe coils located around the outer walls of the house, and, in northern climates, always in the engine pits. The purpose of the steam coils in the pits was to melt ice and snow from locomotives. In doing this, however, the water produced, dropping on the heated coils, caused a large volume of steam vapor, which sometimes fogged the entire house. Later, when more work was required on locomotives standing in the house, workmen found the steam coils in the pits very hazardous.

The more modern houses are heated by the hot-blast system, whereby large volumes of air are heated by being drawn over banks of steam-heated coils, the air thus heated being driven by large fans



Concrete Floors Have Proved Very Satisfactory for Enginehouses

through a system of underground ducts leading to the engine pits. This is an ideal method of heating enginehouses in that the heated air absorbs much of the moisture in the air and thus eliminates much of the fog that would otherwise be present. Such a system of heating also eliminates the danger of steam coils in engine pits. This system is expensive and does not lend itself readily to extension, unless provided for in the original construction.

In new construction, or when replacement of the heating system in an enginehouse is contemplated, consideration should be given to the use of unit heaters. This type of equipment has come into use within the last decade or so, and is quite flexible. Some roads install such heaters near the rear wall of the house and deliver the heated air between alternate stalls. In addition, they install a small heater at one end of each engine pit, which drives the heated air the full length of the pit.

Interior Painting and Lighting

Painting the interior wall surfaces of enginehouses with white or light-colored paint has a number of advantages. The lighter colors improve lighting conditions, promote cleanliness, help the appearance, improve the morale of the employees and reduce accidents. While white is perhaps the most effective from the standpoint of lighting, it is difficult to keep clean where the atmosphere is constantly being charged with smoke and soot. Even where there is an effective smoke-removal system, white walls soon become dingy and dirty in appearance.

Some roads whitewash the interior of enginehouses, especially when the walls are of brick. The whitewash is usually applied with a spray, necessitating the protection of locomotives, machinery and other equipment while the whitewash is being applied. Obviously, the whitewash is suitable only for application to the brick and wood surfaces; steel columns and truss members must be painted with a good grade of paint. Whitewash is more susceptible to smudging with dirt than a good paint, and it must, therefore, be applied at shorter intervals. Yet, repeated applications result in flaking off of the whitewash, thus creating an unsightly appearance of the walls and ceiling, and making it more difficult to keep the enginehouse clean.

More careful thought should be given to the painting of the interiors of enginehouses, especially as to the colors used. For example, grays and buffs may be employed to advantage on walls, with a light yellow on posts and other fixtures. These contrasting colors not only tend to make these members and fixtures stand out in bolder outline, but they also tend to increase the effectiveness of the lighting system and to improve working conditions.

Enginehouse illumination has always presented a difficult problem, due primarily to prevailing dirty and corrosive atmospheric conditions. Along with this, dark surfaces which reflect very little light are usually encountered.

Fluorescent lighting equipment has been developed for this particular application and trial installations indicate its practicability. Two-lamp, 100-watt fixtures with flat white surface reflectors, suitably mounted at a height below the prevailing gas and smoke zone, have been found to supply effective illumination on the sides and tops of locomotives.

Wash and Locker Facilities

Too little attention has been paid in the past to the matter of providing adequate wash and locker facilities for enginehouse employees. Within recent years, various states have passed laws which have tended to improve sanitary facilities. As a result, the maintenance forces have often been called upon to alter or to provide new plumbing fixtures in enginehouses, as well as to construct new, or to enlarge existing locker rooms.

In modern enginehouse construction provision should be made for adequate wash and locker facilities, located adjacent to each other. The wash room should be equipped with modern circular wash fountains supplied with hot and cold water; modern water closets housed in metal stalls of ample width and depth; and modern floor-type urinals. The locker room should be provided with modern jet-spray drinking fountains and should be equipped with modern steel lockers of proper size, fitted with hat rack, clothes hanger bar and ventilated door fitted with hardware for padlocking. The room must be properly ventilated, heated and provided with plenty of outside light, and should be of such size that it will also house a table and benches so the workmen can eat in comfort.

Conclusions

The modern enginehouse should embody the following main features:

(1) Concrete foundations supporting brick or other masonry walls.

(2) Large window areas in the rear wall, preferably of glass blocks.

(3) Timber framing for roof support, a wood deck and a built-up gravel-surfaced roof covering.

(4) Large folding engine doors of wood construction.

(5) Concrete floors and concrete engine pits.

(6) Hot air system of heating, preferably employing unit heaters.

(7) Adequate modern wash and locker room facilities.

Committee Personnel

L. C. Winkelhaus (chairman), arch. engr., C.&N.W., C.St.P.M.&O., Chicago; R. C. Baker (vice-chairman), supvr. b.&b., C.&E.I., Danville, Ill.; Frank Fackler, gen. fore. b.&b. & w.s., A.T.&S.F., Chanute, Kans.; C. A. Hughes, asst. supvr. b.&b., E.J.&E., Joliet, Ill.; H. E. Jackman, mast. carp., B.&O., Chillicothe, Ohio; L. P. Keith, Timber Engineering Company, Chicago; L. P. Kimball, engr. bldgs., B.&O., Baltimore, Md.; F. H. Masters, ch. engr., E.J.&E., Joliet, Ill.; Thos. D. McMahon, arch., G.N., St. Paul, Minn.; I. A. Moore, trmstr., C.&E.I., Salem, Ill.; and O.M. Saxton, dist. mgr., Timber Structures, Inc., Chicago.

Discussion

Referring to that portion of the report on enginehouse roofs, W. A. Huckstep (M. P.) opened the discussion by mentioning that his road uses a heavy rosin paper between the wood deck and the felt roof covering, which, he said, helps prevent condensation and preserves the wood. In this connection, F. H. Soothill (I. C.) stated that for some time his road has used a dry sheet of asbestos paper instead of rosin paper under the first layer of felt.

The problem of heating enginehouses was discussed at some length. Mr. Huckstep favored unit heaters rather than a hot-air duct system and suggested that the former are more economical because the unit heaters can be turned on to heat only as many stalls as necessary. Mr. Soothill referred to that part of the report mentioning a disadvantage in the use of steam coils in pits because of the dropping of water on them from locomotives, causing a cloud of steam to form in the enginehouse. He stated that his road has not constructed enginehouse pits with steam coils in them for a number of years, and that the difficulty with steam coils in earlier installations had been overcome by constructing the engine pit walls with a ledge along the top, protecting the coils below.

In discussing that part of the report referring to damage caused by locomotives accidentally run through the rear walls of stalls, Mr. Soothill stated that his company had adopted a concrete column and beam design for rear walls, with curtain-type con-

struction between columns, thereby greatly reducing damage and the cost of repairs in the event of such accidents. Mr. Soothill went on to discuss firewalls and curtains, stating that a solid brick firewall separating every group of 12 stalls was standard in brick enginehouses on the I. C., and that, in some instances, in frame enginehouses, frame curtain walls, extending about six feet down from the roof and faced with corrugated asbestos siding, had been constructed at intervals to check the spread of fire.

Mr. Soothill also expressed the opinion that the two-leaf-type doors are more economical for enginehouses than sectional doors because they have less hardware to become subject to corrosion. A question was then raised concerning state laws as they affect the clearance afforded by enginehouse doorways, to which R. W. Gilmore (B. & O.) stated that the State of

Ohio requires eight feet clearance on both sides of the center line of the track. Chairman Winkelhaus added that a number of other states, including Wisconsin and Minnesota, also have laws requiring this clearance.

Economical Methods for the Maintenance of Impounding Reservoirs

Committee Report

THE accepted conception of an impounding reservoir in the waterworks field is a natural or partly excavated earthen basin used to store water for future use, as distinguished from a steel or concrete tank. The railroads use reservoirs for the storage of locomotive boiler water in quantities sufficient to carry them over periods of drought or scant rainfall. Reasonably accurate estimates indicate that approximately 10 per cent of all locomotive water supplies are secured from reservoirs, the remaining 90 per cent being obtained from streams, lakes, springs and dug or drilled wells. Normally, reservoirs are costly to construct and costly to maintain, and are avoided when other suitable sources of supply are available. Anything that contributes to a reduction in the capacity of a reservoir or the quality of the water stored therein can be considered a maintenance problem.

K. J. Weir
Chairman

Capacities Vary

Reservoirs vary in capacity from as small as 2,000,000 gals. to as large as nearly 500,000,000 gal. In age, some of them approach 70 years. The earlier reservoirs were usually small, having been constructed by throwing a dam across a small ravine, with a hillside spillway and riprap protection against erosion. Reservoirs constructed during the last 25 years are generally those of greater capacity. In recent years, dams have been designed with greater care, and have been provided with core walls of concrete or piling, and with spillways paved with concrete or riprap. Many of them represent investments approaching $75,000 or more, in land, dams, spillways, clearing and sodding, riprap, etc. Such investments must be maintained and protected to serve a long time with minimum impairment to capacity and water quality.

Excessive evaporation loss, which is influenced most by wind, heat and other weather conditions, is a major difficulty with many reservoirs. These influences can be retarded to some extent by forestation, making the plantings near, but not too close to the water's edge, to obstruct wind, reduce excessive wave action and cool the air. Such timber growth must be well maintained to remove dead branches, twigs, leaves, etc., before they are washed into the water to impair its quality and reduce the reservoir capacity. As much of the water shed area as possible should be planted to timber, heavy sod or grass, and erosion ditches should be promptly filled and their surfaces restored to their original condition.

In the Southern states where malaria is a problem, state and federal laws exist which outline the methods which must be followed in the preparation and maintenance of a reservoir to minimize the production of malaria-carrying mosquitoes. The main requirements are (1) proper preparation of the basin to minimize floating material and growth of vegetation, and (2) a seasonal progressive drawdown of the water level during the mosquito breeding period to maintain a clean shore line. While these features can be made to fit in with railroad requirements, the regulations for impounded waters in the malarious areas are so strict that state health departments should be consulted in these areas before construction is started.

Absorption and Seepage

Absorption in the usual clay soils is generally estimated to reduce the reservoir water level about ¼ in. per day, so particular attention should be paid to the sub-soil strata when selecting reservoir sites, and porous, sandy formations, as well as rocky bases, with possible cracks or fissures, should be avoided. Reservoir sites should be cleared of all plant life, with tree stumps sawed off at grade level or grubbed out altogether, and all of this material should be burned. Pot holes or other breaks in the surface that develop during construction should be carefully filled to minimize absorption.

Seepage through cavernous substrata, which may exist in limestone, sand, glacial drift or similar formations, can present a very perplexing problem which is difficult to correct. One railroad reports a condition of this kind in a 150,000,000-gal. reservoir, which reduced the total capacity by 30 per cent. The condition persisted until the water level

dropped to a point two feet below the spillway, which naturally created a water shortage annually during periods of little rainfall. After locating the leaky area near the spillway base, the condition was corrected by applying about 5,000 cu. yd. of clay in an 18-in layer over the entire area. The work was done during a period of low water level and was effective in stopping all leakage from this source. Prior to applying the clay blanket, unsuccessful efforts had been made to stop the leakage by means of local applications of earth and Bentonite to pot holes observed in the bottom of the spillway.

Another railroad reports difficulty along the eastern seaboard with crustaceous (aquatic water breathing) animals boring around the ends of and beneath the concrete dams of its reservoirs, and suggests the use of bituminous materials for filling cavernous areas or seamy fissures to retard their work.

Silting

Without question, silting is the greatest contributor to decreasing reservoir capacity. This accumulation develops through surface wash over the entire water shed of dirt, mud, gravel, leaves, silt and loam, as well as depositions from farm drain tile. There is no inexpensive way to remove silt from reservoir basins, and the costs of doing such work vary greatly, depending upon conditions. A few examples of corrective measures taken are as follows:

(1) One railroad reports removing 75,792 cu. yd. of material from a badly silted reservoir, at a cost of $26,527, or approximately 35 cents per cubic yard for the material removed. As a result of this work the reservoir capacity was increased 15,000,000 gal., making the cost of the work average $1.77 per 1,000 gal. of added storage capacity. The equipment used in this operation included one 3½-cu. yd. dragline with a 75-ft. boom; two 13-cu. yd. Diesel crawler trucks; and one 80-hp. tractor equipped with hydraulic bulldozer.

All vegetation was cleared and burned up to high water contour, and all excavated material was placed at least 10 ft. beyond high water contour. Excavation and deposit was limited to one cast of the boom, the wasted material being leveled off with the bulldozer when sufficiently dried. Two month's storage was added to this supply as a result of this work.

(2) This same railroad reports an additional interesting problem in the widening and deepening of a creek bed to secure an added 3,900,000 gal. of storage for the annual period when there is no flow in the stream. Many years prior to doing this work the railroad had placed a small low timber dam across the creek bed. In the intervening years silting raised the bottom of the channel, requiring corresponding raises in dam elevation, and these alternate raises eventually resulted in complaints about drainage from adjacent property owners. A total of 19,427 cu. yd. of material were removed from the stream bed, as it was widened and deepened for a distance of 2,000 ft. The work cost $6,664, which averages 34.4 cents per cubic yard of material removed, or $1.71 per 1,000 gal. of additional storage provided.

(3) A Texas railroad reports having successfully increased the capacity of one reservoir from 10,191,440 gal. to 27,633,440 gal. by the removal of 76,467 cu. yd. of material. This work was done with a floating suction dredge at a cost of $33,086, or an average of 43.4 cents per cu. yd., or $1.89 per 1,000 gal. of provided storage capacity.

Special Problem Solved

(4) Over a period of some twenty-six years an Indiana railroad experienced a drop in the capacity of one of its reservoirs from 19,000,000 to 13,300,000 gal., due entirely to silting. This storage was divided into an upper reservoir holding 2,300,000 gal., and an adjacent lower reservoir holding the remaining 11,000,000 gal., the total capacity being equivalent to about five month's normal usage. Extensive studies developed that a number of things could be done to improve storage conditions and provide additional storage. Briefly, these were:

(a) Raise the spillway elevation of the lower reservoir by 1.56 ft.

(b) Clean out the lower reservoir to add 4,000,000 gal. storage.

(c) A combination of (a) and (b).

(d) Raise the elevation of the spillway of the lower reservoir by 5.56 ft., which, in effect, would make one large reservoir.

(e) Raise the spillway elevation of the lower reservoir by 3.56 ft.

(f) Provide a new reservoir below the existing lower reservoir.

In an accompanying table are listed the estimated costs of these several plans and the benefits that could be expected from each.

Plan (e) was finally recommended, but the work has not been completed at this time. The cost figures given above include the acquisition of property and other costs incidental to completing the work.

The American Society of Civil Engineers, in reporting on the subject of reservoir silting last year, concluded that "Prevention of erosion, by checking sediment production at the source, appears to be the best remedy for minimizing the silting of a reservoir." Cost data obtained from the three projects outlined above indicate that reservoirs can be cleaned of silt at less than $2.00 per 1,000 gal. of storage space provided, but these limited data should not be accepted as conclusive for all such work.

Plant Growth—Algae

Aquatic vegetation or underwater plant life does not impair reservoir capacities except to a limited degree, the maximum reduction being about 3 per cent, with an average close to 1 per cent of total capacity. Most of such growth is located near the water's edge, at depths usually not exceeding 40 in. Studies indicate that there is little difference in the stimulating effect of raw and processed sewage on the rate of underwater plant growth; also, that reservoirs which silt rapidly are usually more free of plant growth than those having little silting action. Most aquatic vegetation can be killed by the introduction of certain copper salts in concentrations not harmful to fish or other aquatic animal life.

Algae growth has practically no effect on reservoir capacity, but is a decided detriment to water quality. In sufficient quantities, it causes foaming in locomotives, impairs pump operation, and makes filters ineffective. It can also be controlled by the use of copper sulphate.

The dam, of course, is the most important part of a reservoir, for without it water could not be stored.

Estimated Costs of Various Plans for Increasing Existing Reservoir Capacity

Plan No.	Present Reservoir Capacity	Proposed Capacity of Reservoir	Estimated Cost to Complete	Unit Cost per 1,000 gal. for Capacity Added
(a)	13,300,000	17,300,000	$ 4,000	$1.00
(b)	13,300,000	17,300,000	20,000	5.00
(c)	13,300,000	17,300,000	24,000	3.00
(d)	13,300,000	33,800,000	22,000	1.07
(e)	13,300,000	23,300,000	13,400	1.34
(f)	New	25,000,000	53,000	2.12

Above all else, the dam must be maintained in good condition at all times. Wave-wash protection of riprap should be provided for the water side of the dam, while the downstream side should be planted to native grass or covered with riprap if exposed to high water during periods of heavy rainfall or floods through the area. If planted to grass, this should be mowed frequently to determine that erosion or wash cuts are not developing on the face of the fill. Livestock should not be permitted to roam on an earth dam, and burrowing animals should be exterminated to avoid artificial disturbances to the structure and the subsequent erosion that might develop from such causes.

Spillways

The spillway is the safety valve of the reservoir and nothing should be permitted to obstruct maximum free flow of water through the spillway area during overflow periods. Frequent periodic inspections should be made of the spillway, and logs, brush and other debris should be removed promptly to insure its full availability when required. Fish nets or similar obstructions across the spillway area should not be permitted.

The outlet below the spillway proper must also be kept free of all obstructions so that escaping water will not be retarded, with possible subsequent injury to the dam. Repairs should be made promptly to concrete paving to avoid excessive washing and undercutting, with possible loss of the entire spillway structure.

Water Shed Area

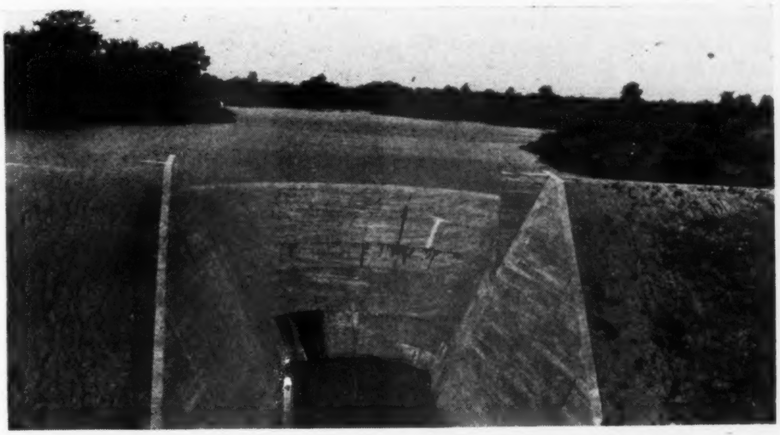
Where possible, it is desirable to patrol or control the entire water shed, but this can seldom be done because the railroads usually own or control the property only to the floodway contour. As indicated previously, it is important that dead plant growth be removed from the water shed area, that erosion ditches be promptly filled, and that other corrective measures be taken when discovered through patroling the area.

Patroling is also desirable on portions of the watershed not owned by the railroad, and particularly so in areas where oil well drilling is prevalent. Established reliable oil companies usually observe state regulations in drilling, or follow practices which protect downstream owners from oil well pollution. "Wild Cat" operators, however, are not so careful, and it is their operations which must be watched to prevent damage.

In general, we might conclude that the investments by railroads in reservoirs, dams and spillways are relatively so large that definite maintenance practices must be established to protect these investments and to insure their continued, most effective use for railroad operation. Also, that silting presents the greatest maintenance problem, requiring intensive study of all possible methods for improving reservoir capacities prior to undertaking the costly work of cleaning the silt from the basin of the reservoirs.

Committee Personnel

K. J. Weir (chairman), supvr. fuel & w.s., C.M.St.P.&P., Chicago; J. P. Hanley (vice-chairman), w.s. insp., I.C., Chicago; S. E. Bateman, w.s. fore., M.P., Poplar Bluff, Mo.; L.A. Cowsert, water insp., B.&O., Dayton, Ohio; A. H. Frisbie, w.s. fore., C.&N.W., Sioux City, Iowa; F. M. Ginter, w.s. fore., Alton, Bloomington, Ill.; B. J. Howay, supvr. b.&b. & w.s., P.M., Grand Lodge, Mich., G. H. Johnston, gen. fore., b.&b. & w.s., A.T.&S.F., Marceline, Mo.; C. R. Knowles, supt. w.s. (retired), I.C., Chicago; Virgil Leak, gen. fore., b.&b. & w.s., St. L.-S.F., Tulsa, Okla.; Guy Martin, supt. w.s., I.C., Chicago; A. N. Matthews, gen. fore. w.s. & b.&b., St., L.-S.F., Ft. Scott, Kan.; Wiley V. Parker, ch. engr. asst. U.S. Public Health Service, Memphis, Tenn.; L. F. Phol, div. engr., C.M.St.P.&P., Ottumwa, Iowa; Gary Smith, w.s. fore., N.Y.C., Rochester, N.Y.; M. P. Walden, asst. supvr. b.&b., L.&N., Evansville, Ind.; Shirley White, supvr. dam const., Bonita Dam, S.P., El Paso, Tex.; and D. M. Yaw, asst. supvr. b.&b., Erie, Youngstown, Ohio.



Railroad Reservoir with a Concrete Spillway of Unusual Design

Discussion

G. E. Martin (I.C.) opposed the leasing of reservoirs for fishing or boating purposes and the use of the

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grounds surrounding reservoirs for picnics by church, civic and other organizations. It was his contention that much damage occurs in some cases where this is done and that the trash and debris that result from such parties invariably get into the reservoir, polluting and degrading the quality of the water.

J. P. Hanley (I.C.) called attention to the desirability of clearing all timber from the borders of reservoirs and of keeping vegetation under control so that it will not grow rank and eventually pollute the water.

Commends Report

C. Miles Burpee (Ry. Eng. & Maint. Cyclo.) commended the report, not only on its completeness, but on the ground that it provides a manual for the guidance of the men in the field, who generally have no other literature to which they can refer when some of the problems mentioned in the report confront them.

In response to a question by R. E. Dove (Ry. Eng. & Maint. Cyclo.) concerning the patrolling of reservoir sites and of the watershed areas, Messrs. Wier and Hanley both said that this is done more or less informally by employees of either the water service department or by some one from the section forces, who might be assigned to this task from time to time. It was also brought out that where a reservoir is in a section where oil is being brought in, it becomes necessary to patrol the watershed regularly and persistently

to prevent pollution by waste oil and also by salt water. It was emphasized that while regular operators must be watched closely, it is the wildcat prospectors that usually give the most trouble. It was also brought out that in some of the eastern states inspectors from the state departments of health patrol watersheds draining into reservoirs from which water is taken for drinking or culinary purposes.

New Developments in Interior Painting

Committee Report

DUE to war-time conditions, with the consequent shortages of many of the usual materials entering into the manufacture of paints, substitutions of many kinds have been made in paints and a number of manufacturers readily admit that the results have been a poorer product that will not be continued when proper formulation again becomes possible. Furthermore, just prior to these shortages, manufacturers were developing many new and interesting materials to obtain different effects than had been possible with the older formulas, and to develop more lasting finishes. Such developments on a commercial basis had to await the end of shortages of and restrictions on materials, but the manufacturers continued their laboratory research, with the result that, now that the war in Europe and the Pacific is over, these new developments in materials will soon become available.

L. E. Peyser
Chairman

Among the interesting experiments that have been worked on by one manufacturer is the formulation of a paint which will contain a material lethal to insects, such as flies, roaches, etc.

In the development of opaque, pigmented finishes, the trend has been toward the use of softer, scientifically chosen colors, with hues subdued in tone, unobstrusive and practical, so as to lessen eye strain and fatigue. In addition to the consideration of these correct color combinations, industrial interiors are made to have a very low sheen, and sometimes no sheen at all, to reduce glare. The only places where gloss finishes are recommended are in areas subject to becoming soiled, requiring frequent washings.

Types of Finishes

The foregoing materials are divided into two general classifications, namely, the oleoresinous materials, and the water-base, oil-bound materials (emulsion paint). The oleoresinous materials are the standard interior types of finishes, varying from a full gloss to one having no sheen. They are composed of opaque pigments and a vehicle of processed drying oils compounded with natural or synthetic resins.

The resins involved, when processed with various types of drying oils, such as china wood oil, oiticia oil, or dehydrated castor oil, produce finishes which give four-hour drying. Synthetic alkyd type of resin, when used, produces finishes which are rapid drying, and can be made either in orthodox formulation, using regular paint thinners, or into emulsion-type paints, requiring water reduction. When usual turpentine or paint thinner is used, the drying time is from four to eight hours. The water-base, oil-bound emulsions will produce a semi-gloss or flat finish. These have a drying time of one to two hours and are characterized by having minimum odor during and after application.

Transparent finishes, usually clear varnishes, lacquers or shellac, are used mainly on woods where it is desired that the natural color be maintained, and for the protection of floor coverings, such as linoleum. Here too, a low-sheen finish is used, except on those areas which are subject to heavy wear.

There are on the market numerous so-called "one-coat" interior finishes, most of which are of a casein composition. It is felt that these paints should not be considered generally for railroad use since they are somewhat lacking in wearing qualities and must be removed when it is desired to apply a more lasting finish. The process of removal is a difficult one, however, these finishes have their uses in locations where low first cost is desirable due to impermanence of occupancy or for other reasons, and formulators are attempting to develop further these non-penetrating coatings. Their principal value is in coating over such surfaces as calcimine and wallpaper, and provide a surface with some of the washability of oil-type paints.

Other Finishes

This type of materials is not to be confused with other interior finishes, which, while they cannot be classed as a real oil paint, have, however, various types of oil in emulsion. These latter finishes may be considered as good material for use in such locations as offices, where usage is not too severe and where refinishing is normally done frequently for reasons of appearance or to retain a good light-reflective surface. While this type of material is said to be washable, such great care must be used in washing it that it is probably about as economical and, therefore, preferable, to give it a rough washing sufficient to provide a surface for an additional coat.

Other and, no doubt, better interior finishes are really washable wall paints, which, because of their composition, are truly oil paints that can be washed several times if a mild soap is used. In the long run, these readily washable paints are the most economical.

Calcimines and Enamels

Calcimines have no place in railroad structures, and while cheap in first cost, they are short-lived, are damaged easily, and quickly absorb grime. When refinishing is required, the material must be removed by a thorough washing and, thus, in actual practice, calcimines are nearly as expensive in application as a superior material.

For special uses, such as in hospitals, public toilets, or other locations where frequent washing is necessary for reasons of cleanliness, enamel finishes are indicated. Prior to the war-time changes required in paint formulation, several enamels of very special composition were available, the vehicles of which, in some cases, were forms of lacquer, and in others, superior varnishes. These enamels were

The Use of Proper Colors in Shops Should Not Be Overlooked

ideal for use where the highest grade enamel finish was desired, being of extremely long life and resistant to washing, while remaining true to color and retaining their high gloss over many years. Those having lacquer vehicles had the added advantage of quick drying and little offensive odor, so that areas in which they were used could be returned quickly to service.

Recent interviews with manufacturers of this type of material elicited the information that while the labels were the same as before the war, the contents of the can had deterioriated, and that the material was only the equivalent of any good enamel. However, they pointed out that when the necessary ingredients again became available, the original quality of their products would be restored. The formulation of these finishing materials is, of course, a trade secret of the manufacturer.

Trends in Color

For too long a time we have been inclined to the use of drab, dull, uninteresting colors, a fact which applies in its relation to other things, as well as buildings. The easiest way in this, as in other things, has been to continue over the years in the same manner as in the past. Fortunately, however, this phase appears to be passing, and we are becoming color-conscious.

The railroads cannot expect to impress their patrons with their progressiveness if they continue to maintain the entrances to their modern, beautifully-decorated streamlined trains thru uninteresting, colorless waiting rooms and other public spaces and facilities. Other and smaller businesses than railroads are keenly aware of this, and seek the aid of color to assist them in selling their services or merchandise to the public. It is not necessary or desirable for us to use blatant colors, such as might be proper in a second-rate movie palace, to sell our services, but the use of proper colors can be developed to produce a dignified composition which would, at the same time, be inviting and cheerful.

The use of color is not any deep mystery, but rather only a matter of careful thought in selection by persons having some natural talent. Careful selection must, however, be made, since a slight variation in shade sends a color from good to bad, and there is no such thing as a "nearly good" color. It is either right or wrong. By the proper selection of color, the entire character of a building can be changed and modernized.

The railroads are burdened with many structures of so-called rennaissance style, which were formerly decorated in numerous colors, carefully emphasizing each detail of ornamentation, of which there was usually an over-abundance. By the proper use of color, such buildings can be brightened and enlarged or opened up in appearance, and their lighting greatly improved. The ornament may be

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painted out, thereby subordinating it and relieving any overcrowded feeling. This, when well-carried out, will result in a modern effect, without structural changes and, of course, at vastly less cost.

After the selection of colors has been made, there is the further possibility of obtaining interesting effects through the use of texture, such as block or brush stippling, roller stippling, or the broad knife application of paints thickened to a plastic consistancy by added inert extenders.

Colors in Shops

In considering the painting of structures, the use of proper colors in shops should not be overlooked, and schemes should be developed whereby lighting conditions will be improved and, as far as possible, the hazard of accidents will be reduced. A great deal of research has been made by paint manufacturers to develop colors for these purposes, and there is no doubt but that the proper selection of color for use on both the structure and machines has accomplished very desirable results, not alone in lighting and safety, but also in improved employee morale.

In at least one case, a supervisory officer has stated that, after a shop had been repainted in the modern manner, employees not only began to take pride in their machines, but production noticeably increased. In-

Passenger Station Interiors Lend Themselves Particularly to the Effective Use of Color to Produce a Pleasing, Dignified Atmosphere

creased production is logical, since the workman is protected in a measure from the hazard of accident, leaving him more time for actual work.

A further consideration in connection with painting is its relation with lighting, and several manufacturers of paints have worked in collaboration with lighting engineers to produce a combination of color and correct light to reduce eye-strain and, consequently, fatigue. In selecting the colors, studies were carried on as to light-reflecting qualities, hue characteristics, and the phychological reaction. This, in effect, has resulted in the development of schemes whereby color may be properly selected for use from front to rear door. Only a few colors in combination need be utilized to produce good results.

Data from this research by manufacturers are available in a form that is readily understandable, and from which schemes for all but the most complicated problems may be developed. Further, these manufacturers are glad to have their technicians work in co-operation with those confronted with or interested in such problems, and we should avail ourselves of this service whenever it would be advantageous to us to use.

Through long years of conditioning, we have become imbued with the idea that the prime function of paint is as a preservative, and that any other purpose is a poor second. This is not entirely true in interior painting, where the functions of preservation, appearance and psychological effect are equally important factors, with possibly the latter two the more important.

It is necessary, therefore, that due consideration be given not alone to the selection of the proper material for each particular condition, but also to the color or combination of colors most suitable.

Committee Personnel

L. E. Peyser (chairman), prin. asst. arch., S.P., San Francisco, Cal.; T. H. Strate (vice-chairman), div. engr. C.M St.P. &P., Chicago; F. W. Dayton, arch. drafts., C.&N.W., Chicago; John Hayes, asst. arch., G.N., St. Paul, Minn.; K. E. Horning, arch. drafts., C.M.St.P&P., Chicago; W. A. Huckstep, gen. bldg. supvr., M.P., St. Louis, Mo.; A. C. Johnson, asst. supt. b.&b., E.J.&E., Joliet, Ill.; Paul Knapp, mast. carp., Erie, Buffalo, N. Y.; A. B. Nies, arch., M.C., Detroit, Mich.; H. J. Powell, painter fore., N.Y.C., Malone, N.Y.; R. D. Baker, National Lead Company, New York, N.Y.; L. F. Flanagan, Detroit Graphite Company, Chicago.

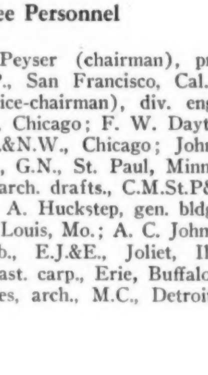
Discussion

In the absence of L. E. Peyser, chairman of the committee, this report was read by W. A. Huckstep (M.P.) one of the members of the committee. N. D. Howard *(Ry. Eng. & Maint.)* pointed out that the report contained a lot of valuable information which had been carefully condensed, and emphasized the increasing attention being given the artistic and scientific use of color in interior painting. He mentioned specifically severals roads, which he said were giving special attention to the proper use of colors for interior shop decoration to improve lighting and safety conditions, as well as to provide more attractive working conditions and to increase worker efficiency. Mr. Howard also mentioned effective experiments in interior painting being made in the chemical and physical laboratories of the Chesapeake & Ohio at Huntington, W. Va.

Piles, Pile Driving and Exploration

Committee Report

THIS subject received considerable attention in an association report in 1942, and the results of the investigation at that time appear in the proceedings of the 49th annual convention of this association under the subject Piles and Pile Driving. Here, therefore, it will be sufficient to consider only those phases of pile driving phenomena not treated or not fully discussed in the earlier report. Since the time of that report no noteworthy changes or improvements have been made in the usual pile types, nor have any new types of importance been developed.



W. F. Martens
Chairman

H Piles

Although the manufacture of H piles dates back 37 years, some railroads have only recently started to utilize them in bridge construction. Since H piles have the ability to withstand long-continued hard driving, they can be driven to depths which, until a few years ago, were considered impractical, if not impossible. There are records to indicate that H piles have been driven to depths well over 200 ft. H piles may subsequently be encased in concrete to form a solid pier, or, under certain conditions, the rows in each cluster may be stabilized by welded horizontal and diagonal channel or angle bracing in both directions. Steel caps and corbels are employed for bridge seats. By varying the number of piles, piers constructed of H piles may be designed for any type of superstructure or super-imposed load.

The influence of this type pile is already evident in recent pier designs. Piers can now be constructed in water at depths impossible of attainment with the pneumatic caisson method, thus making possible the use of shorter and less expensive bridge spans in lieu of the costly suspension and cantilever spans formerly necessary for deep water crossings. This type of pile has also had an influence in recent designs of structures for crossing the usual run of water courses.

In 1946, the Santa Fe contemplates replacing a bridge, consisting of five 60-ft. and three 100-ft. through girder spans, with ten 30-ft. and six 50-ft. I-beam spans, re-using the present piers and abutments, and constructing additional piers each consisting of a single row of H piling encased in concrete from the scour line to the bridge seat. The piles are to be driven in a

single row similar to a bent in a pile trestle except that a pier is formed when the concrete is added.

Examples of H-Pile Structures

In 1941 it became necessary for this road to construct a new bridge on its San Diego line. Exploratory work, consisting of wash borings and the driving of test steel piles 135 ft. long, disclosed definitely that suitable foundation material could not be reached at an elevation less than 90 ft. below the river bed. H-sections were used here for foundation piles with satisfactory results, thus precluding the use of the dangerous and more expensive pneumatic caisson method.

The Southern Pacific has utilized H piles for bents supporting 30-ft. I-beam spans where the height from base of rail to ground line does not exceed 20 ft. Six 14-in., 87-lb. H piles, encased in reinforced concrete from the bridge seat to about 5 ft. below the ground line, are used for piers in certain soils. This railroad has used the lighter 42-lb. H-section under piers where the piling is always below ground line. Many other railroads have used H piles for bridge piers with unfailing success. This type of pile may also be used inside of large steel tubular piles to increase their load-carrying capacity.

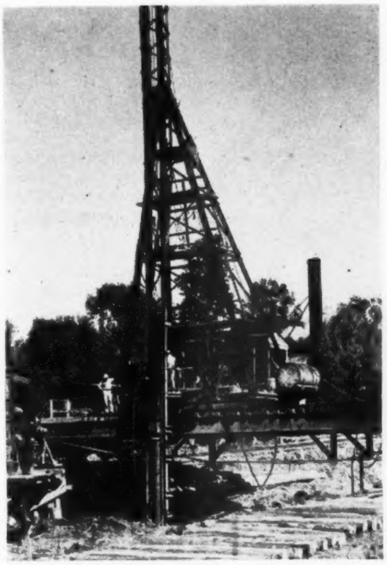
Advantages of H-Piles

The H pile has capacity to develop high bearing value when driven into hard material such as hardpan, caliche or shale, or when bottomed on bed rock. Other advantages are high column strength; small soil displacement, which reduces heaving of the ground, permitting close spacing where necessary; immunity from insect attack; and ease of splicing. Furthermore, H piles are not easily damaged by overdriving, but if this should occur there will be evidence of it in the way of buckling near the top. Owing to the weight of the heavier sections, sturdy equipment is required to drive the longer H piles. Also, transportation charges must be taken into consideration.

Cast-in-Place Cased Piles

This type pile was described as the "fluted type" in the 1942 proceedings. This pile has the advantage of light weight and, therefore, is easily transported and can be driven with a standard rig. In normal times it is available in many ranges of tapers and diameters, as well as thickness of the metal shell. This pile has the further advantage of affording an opportunity for inspection after driving, and, in most cases, if any irregularities exist, they can be corrected without the loss of the pile.

The Missouri Pacific recently completed a reinforced concrete trestle over the Morganza floodway in Louisiana. It consisted of six hundred 31-ft. 3 in. T-beam spans supported on 599 concrete piers and 2 concrete abutments. The 24 bayou crossing piers and 2 abutments are supported on cast-in-place cased concrete piles. The fluted steel shells of these piles were of 7-gauge metal, the bottom section of each pile being 40 ft. long, with a tip diameter of 8 in. and a butt diameter of 18 in.—the 18-in. diameter being maintained for the remainer of the pile in each case, which varied from 75 to 110 ft. in overall length. All of the cast-in-place cased piles were driven to refusal, with the tip coming to rest in sand at an elevation of 75 to 91 ft. below cut-off.



Driving Fluted Steel Shell Piles To an Elevation 75 to 91 Ft. Below Cut-Off

Long Piles Spliced

In driving the piles, more than 200 blows were generally required for the last foot of penetration, using a Vulcan No. 50C double-acting steam pile hammer having a total weight of 11,782 lb. and employing a 5,000-lb. ram that develops 15,100 ft. lb. energy. Sometimes as many as 300 blows were required to drive a pile 5 in. and, for a test, one pile received 400 blows to sink it 1 in. The tapered bottom sections were 40 ft. long and the top or splicing sections came in 20-ft., 30-ft. and 40-ft. lengths. The added sections were spliced on by crimping the bottoms of the upper sections and forcing them into the tops of the sections

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immediately below from 12 to 18 in. and then electrically welding the joint with a 3/16 to 3/8-in. bead, thus making a watertight job.

Accurate measurements were made of the spliced sections so that any telescoping that might result from driving could be detected. The inside of the pile shell was inspected by means of a suitable electric light and, in addition, the length was checked with a steel tape to determine if there were any joint failures; none were found. One of the first pile shells to be driven developed a split seam, which permitted water to enter and fill the shell. The shell was cleaned out and pumped dry before the concrete was placed. Close inspection of the remaining shells revealed that, in several sections, the manufacturer's plant-welded seam had completely missed the joint for short distances. The defects were corrected in the field by the electric welding process and no further difficulty was experienced.

All pile shells were filled with concrete several days before the concrete in the footings was placed. The top 18 ft. of each pile was reinforced with a cage consisting of eight ¾-in. bars equally spaced and held in position by ¼-in. hoops, 12-in. diameter and 24-in. apart. The ¾-in. bars extended about 24 in. above pile cut-off and were hooked to provide proper bond to the super-imposed footing concrete. The other 575 piers in this bridge were supported on untreated wood foundation piles. Since the ground water elevation in this area is constant, these piles will always be under no less than one foot of water.

Pile Driving

Generally, in many sections of the country, neither soil formations nor stream velocities will justify the driving of piles in pile trestles or pier foundations beyond penetrations sufficient to develop the necessary bearing capacity. On the other hand, in other sections and locations it is imperative that the piles in such structures be driven to depths safely below the scouring action of streams, irrespective of the excess bearing power that may be developed, so as to be reasonably sure that damage will not result from washouts during floods. In most instances this cannot be accomplished with the old and light steam pile hammers acquired many years ago, regardless of make, and still in use on many railroads. A heavier

steam hammer, and one that employs a heavy ram compared with the total weight of the hammer, will, in some cases, bring about the desired results. However, in many other instances even the heavier and more modern hammers will not produce the necessary pile penetration, and some other means must be introduced.

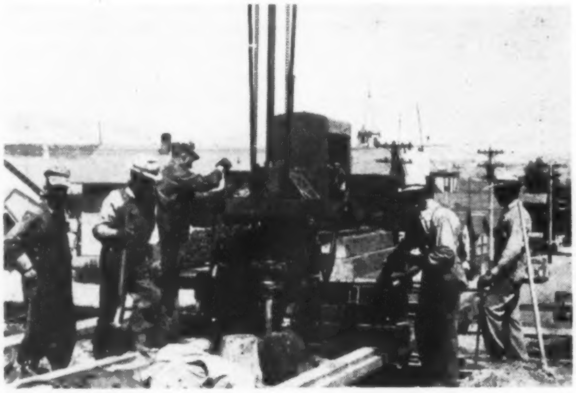
Water-Jet Process

Under such conditions, the water-jet process is in many instances the only method by which piles can be put down successfully to the desired depths. In the early part of the present year, the Santa Fe, in constructing a new 21-span pile trestle in the main track of its Los Angeles-San Diego line, across a slough extending in from the ocean, was unable to obtain more than 24-ft. average pile penetration, even though a No. 1 Vulcan single-acting steam pile hammer was employed which weighs 9,600 lb. and utilizes a 5,000-lb. ram that develops 15,100 ft. lb. energy. This penetration was considered inadequate and a six-stage, gasoline-engine-driven centrifugal jetting pump was moved in, the suction of which was connected to the discharge end of a 40,000-gal. per hr. self-priming pump.

This set-up precluded the use of a foot valve in the suction line which, as a rule, presents difficulties if used in streams that carry considerable loosened marine growth, or where the tide regularly ebbs and flows, as was the case here.

A 2-in. inside diameter jet pipe 35 ft. long, nozzled down to 1 in., was used with excellent results. After some experimenting, the best performance was obtained by working the jet pipe down into the ground for its full length, which required about 20 sec., and then continuing operation of the jet pump for an additional 3 or 4 min. at normal pressure of 250 lb. per sq. in.; thence reducing the pressure to about 60 lb. per sq. in. until the driver returned from shore with a pile a few minutes later, at which time the pressure was restored to 250 lb. to provide an adequate volume of water to carry the loosened material to the surface while the jet pipe was being lifted from the jetted hole. This procedure permitted the piles to be driven home, without further jetting, to an average penetration of 42 ft. in 10 to 12 min., or 16 ft. deeper than was previously possible in the much longer driving time of 32 min.

Although some of the piles, upon reaching final penetration, moved as much as an inch per hammer blow, it was found, on going back on a few of the piles the next morning for test purposes, that any number of blows would not produce additional movement. Here the soil formation consisted of compacted fine ocean sand mixed with some finely broken sea shells.



Preboring For Piles With Power Earth Drills Offers a Number of Advantages Under Certain Conditions

Other Examples of Jetting

In another instance a few weeks later, this railroad, in redriving a pile trestle on a branch line near San Bernardino, Cal., again failed to obtain sufficient pile penetration. Here, the jetting equipment already described again produced additional and satisfactory pile penetration. This time the ground formation consisted of water-laden coarse gravel strewn with some boulders of moderate size, tree trunks and a lot of old pile stubs.

In 1943 it became necessary for this railroad to drive a trestle for a second main track in the San Bernardino area in ground where previous pile driving experience indicated that difficulty would be encountered. However, since the earlier experience in this territory, a new and more modern pile driver, using a heavy hammer, had been acquired, and it was decided to start operations by driving the piles in the usual manner. Even though a double-acting hammer of recent design was used, which employed a heavy ram and developed a rated energy of 15,100 ft. lb., the piles refused further penetration on reaching an average penetration of only 8 ft. Here, a six-stage centrifugal jetting pump, used in conjunction with the steam pile hammer, resulted in securing an average pile penetration of 15 ft., which was well below the scour line of the stream and, therefore, adequate.

In this case the soil formation was made up of extremely coarse ground, with pockets of tightly packed boulders varying in size up to 18 in. These pockets extended for some distance below each down-stream batter pile in the trestle carrying the adjacent track. As the new piles had to be driven on line of the bents in the existing structure, there was no way of avoiding these unfavorable soil conditions.

Although this job proved difficult to handle, it was completed successfully at a reasonable cost and without unduly disturbing the surrounding soil structure. The latter factor is important in streams carrying considerable drift wood, since this debris lodges against the bents, forming a floating dam, which forces the water downward with terrific force and scouring action. A soil that has been thus greatly disturbed offers little if any resistance, and is soon washed away, exposing the piles to such an extent as to cause failure of the structure.

Since the water jet process is the most effective means yet devised for sinking piles under the conditions described, it is difficult to understand why it has not come into more extensive use. It is true that, in the so-called desert regions where much of the difficult soils are encountered, and where the need for jetting piles is most urgent, an adequate supply of surface water is not often available at the site of the work. Under such conditions the officer in charge of the project is confronted with the problem of hauling in water in tank cars, the cost of which, to some operating officers, seems excessive, if not prohibitive. The expense, however, is not always as great as it would first appear.

Water for Jetting

The lack of free water for jetting at a project site is not an insurmountable obstacle, and certainly not sufficient reason to condemn a proven method. In normal times tank-car equipment can generally be made available for hauling jetting water, the cars being filled at the nearest water station, which, as a rule, is not more than 25 miles away.

Experience has shown that piles can

sometimes be jetted enough to be driven to required depths with a surprisingly small amount of water. In other instances, where modern excavating equipment is used, an adequate sub-surface water supply can be developed at the job location at small expense. In other localities, a considerable amount of the jetting water can be reclaimed as the work progresses. It is also possible, in many instances, to program the work during the season of the year when streams are flowing water, which in some cases extends over a considerable period of time.

The foregoing obstacles, however, do not explain why the water jet has not been utilized to a greater extent where the water supply is not a problem. Perhaps in years gone by attempts were made to utilize some old piston-pattern steam pumps released from other service and entirely unsuited for jetting, because no other equipment was at hand. The advent of modern self-contained pump units

Investigating a Foundation Site By Means of Wash Borings

especially designed for jetting service should tend to increase this method of driving piles in the future.

This discussion should not be construed to indicate that the water jet will produce satisfactory results in every case. Like all others, this method has limitations, and should, therefore, be confined to soils favoring its use. In other soil types difficult to penetrate, it is usually better to preform holes for the piles, using a power-driven earth drill.

Power earth drills can be mounted on a railroad push car, trailer, skids, auto truck, or other vehicle, and will drill holes in hardpan, shale and other tough formations. By proper planning, boring operations can be carried on during intervals between trains too short to permit driving a pile. Also, boring operations and pile driving can be done simultaneously. In addition, preboring with this type of rig will minimize the possibility of damage to adjacent building foundations or to underground installations such as pipe lines, due to shock or vibrations being transmitted through incompressible earth formations. Pilot holes may be bored with this machine to facilitate the placing of piles otherwise too long to go under the hammer or to permit the piles to be set accurately in the proper position.

Hard gravel formations sometimes make it difficult to start the pile with any degree of accuracy unless the hole is prebored. Preboring also lessens the possibility of brooming.

Exploratory Work

Generally, the test pit furnishes more information than other methods of exploration. Although, before the advent of modern excavating machinery, more costly than other methods, particularly where extensive depths were involved, pits can now be dug at reasonable cost. The test pit provides the opportunity to examine variations in the texture of the formations encountered, as well as the density of the soil strata in its natural arrangement. This method of soil exploration should be limited to dry and well consolidated soils, as pits dug in loose and wet ground will require substantial timbering or other type of cribbing, the cost of which may be prohibitive. Test pits can be sunk by hand with pick and shovel, or with a locomotive crane, crawler crane or truck crane, employing a clam shell bucket for doing the digging work.

Borings

Several methods of making test borings have been developed. Frequently, the apparatus used consists of an earth auger, having the appearance of an ordinary wood auger, about 2 in. in diameter, attached to a section of pipe usually 1 in. in diameter, with a cross-bar handle of suitable length at the top. The auger is extended by sections of pipe, as a rule 5 ft. long, as the work progresses. Water is generally poured into the holes as drilled to make clay soils easier to cut and sand and other loose soil spoils cohesive, so that the material may be brought to the surface of the ground.

Sometimes a layer of sand or other loose material may be encountered that has insufficient stability to support the wall of the hole, allowing the

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material to cave-in, filling the hole and obstructing boring operations. To overcome this, the hole must be cased with some kind of metal pipe. When borings of considerable depth are to be made, it is usually best to start with a hole large enough to permit the use of steel pipe of proper size, if this expedient should become necessary.

Sometimes post-hole augers have been used in digging test holes up to 20 ft. deep with fairly good results. The auger is extended by sections of pipe not unlike those used with the earth auger. This method is so simple as to require no detailed description in this report.

Wash Borings

This method can be used for most types of soil, even those containing an occasional boulder, if it is not too large. The conventional rig consists of a tripod with 4-in. by 4-in. or 4-in. by 6-in. wooden legs about 20 ft. long, a small gasoline-engine-driven triplex pump with a winch head, a hollow drill pipe, a drive weight, sections of casing, and the drive head pipe. Extra-heavy pipe three inches in diameter and in lengths of about five feet is, as a rule, used for the casing. The casing is driven by means of a weight with a slot on one side, that fits around a drive pipe, which is threaded to screw on the top section of casing by means of a special outside coupling. The drive pipe acts as a guide for the drive weight, which is operated similar to a drop hammer, with a rope passing through a snatch block suspended from the tripod head and thence to a winch head—all manipulated by one man.

The casing is sunk only as far as is required to maintain the wall of the hole. The hardness of the material penetrated determines the distance the casing is driven before cleaning operations are commenced.

Heavy steel pipe, 1 in. to 1¼ in. in diameter, and in 5-ft. lengths, with threaded couplings similar to those used for the casing, is utilized for the drill pipe to loosen and wash out the soil in the casing. The top section is equipped with a hollow-pipe cross-bar handle and a swivel shackle for rotating the pipe. A hollow cutting bit of any one of various styles is attached to the bottom section. In the boring operations the soil is cut loose by working the drill pipe up and down like an old type churn drill, giving

it a quick twist as it reaches bottom. The churning action is accomplished with the aid of the rope used to manipulate the drive weight. A stream of water is forced down through the drill pipe and cutting bit at the rate of 30 to 60 gal. per min. by means of the small triplex pump, at a pressure of about 50 lb. per sq. in. The water then passes up through the annular space between the wash pipe and the casing, carrying with it the loosened material. The fluid passes out through a port in the side wall of the drive pipe section at the top of the casing. The water and excavated material should be collected in a receptacle of suitable size, such as a large tub, from which samples can be gathered later for observation and recording.

Blasting Obstructions

If boulders are encountered that are not too large, a small charge of high explosive (gelatin) may be used to dislodge or break them. Care must be exercised to raise the casing high enough after the charge has been placed, and before stemming is applied, if it is needed, to prevent any damage to the casing from the explosion.

To handle the blasting operation expeditiously and with utmost safety, the charge should be detonated by means of electric blasting caps and an approved type of blasting machine. This method of exploration does not always prove entirely satisfactory as the finer material goes into suspension and may be carried away where the wash water is not reclaimed, leaving only the coarser material to be examined. This can be minimized to some extent by holding the drill pipe a short distance above the bottom of the hole until the water flows out clear, after which pumping is discontinued. The drill pipe is then withdrawn and the cutting bit is replaced with a piece of open pipe. The drill pipe is then reassembled in the casing and is driven into the ground for a specimen, after which the drill pipe is taken out and the specimen removed for observation and recording. While the samples thus taken may not be undisturbed specimens, they do reflect sufficient information concerning the soil formations to determine the depths to which piles can be driven.

Large Boulders

The sampling is repeated each time a change in the character of the formation takes place. If a large boulder is encountered, it may not always be possible to distinguish it from bedrock. Additional boring at different locations nearby will generally give the desired information in this particular instance.

In spite of these disadvantages, this method of soil testing provides a means of sampling, both expeditiously and economically, many types of soils to considerable depths. When a test hole is completed, the casing is lifted from the ground either by means of block and tackle or by the drive weight operated in reverse. The rig is then moved to the next hole location and the soil testing operations are again repeated.

Core Drilling

The core drill method of soil testing employs equipment somewhat like that described heretofore under wash borings, except that it utilizes a rotary hollow drill rod, to the bottom of which is attached a bit using black diamonds. Sometimes steel bits with teeth, or bits making use of steel shot, are employed with satisfactory results. As the name implies, this type of soil sampling produces a core which is lifted from the hole at proper intervals. Subsequently, the core can be reconstructed to reflect a true picture of the formations encountered at various elevations. This method is especially adapted to the sampling of rock and shale formations.

Sounding Rod

The sounding rod method of exploration employs a steel rod or pipe of suitable size, usually not exceeding one inch, and in sections about five feet long. The sections are assembled by means of outside threaded couplings so designed as to permit the machined ends of the rod or pipe sections to fit up uniformly and thus relieve the threads of stresses during driving operations. A driving cap is used on top, and the bottom section is pointed. A point slightly larger than the body of the rod or pipe will facilitate driving operations in some soils.

A sledge hammer of proper size is usually used to drive the rod into the ground. A driving ram, consisting of a section of extra-heavy pipe, open at one end and large enough to slip freely over the rod, has been used with good results. The ram is raised by hand and, in falling, strikes the driving cap screwed on the top of the rod.

This method of testing is not always reliable, since soils with obstructions, such as boulders, logs, etc., may stop operations altogether. Furthermore, the information thus obtained may be so inaccurate as to hamper seriously subsequent pile driving operations. On the other hand, this method has been used successfully to considerable depths in soil favoring its use. Simplicity of equipment and low operating cost are its main attributes.

The power-driven boring machine placed on the market a few years ago, and since used so satisfactorily in connection with preforming holes in formations otherwise difficult, if not impossible, for piles to penetrate, may also be utilized advantageously for soil exploration in ground that will maintain the wall of the bore hole reasonably well. Standard machines will bore holes up to 24 ft. in depth and from 13 to 30 in. in diameter. For lesser depths, drills up to 42 in. in diameter are available. Special machines for boring to depths up to 50 ft. are also built.

Exploration Reports

The findings of exploration work should be submitted in a report that will reflect all pertinent and worthwhile information, such as the composition and degree of consolidation of the soil at the various elevations for each location. These reports, after serving their immediate purpose, should be filed away for future reference.

Committee Personnel

W. F. Martens (chairman), gen. fore. B.&B.&W.S., A.T.&S.F., San Bernardino, Cal.; J. P. Dunnagan (vice-chairman), engr. br., S.P., San Francisco, Cal.; J. R. Showalter (vice-chairman), br. engr., M.P., St. Louis, Mo.; J. R. Burkey, cons. engr., Union Metal Mfg. Co., Canton, Ohio; A. B. Chapman, br. engr., C.M.St.P.&P., Chicago; D. W. Converse, asst. engr., A.C.&Y., Akron, Ohio; Lee Mayfield, asst. engr. str., M.P., Houston, Tex.; J. F. Seiler, prin. engr., A.W.P.A., Chicago; Joseph Smith, asst. B.&B. supvr., S.P., Sacramento, Cal., and Fred J. Steward, port. engr., Port Everglades Belt Line, Port Everglades, Fla.

Discussion

F. R. Spofford (B. & M.) stated that when a construction project involving the driving of piles is to be carried out under contract, care should be taken to insure that all information obtained in the sub-surface investigation is made available to the contractor. J. R. Burkey (Union Metal Mfg. Co.) pointed out that on a number of railroads in the east, the handling and driving of hollow tapered steel piles had been carried out with off-track equipment with gratifying results. He also referred to a project in which it was necessary to drive piles in a situation where the overhead clearances were limited. This was

done, he said, by using the hollow steel piles and driving them in short sections which were welded together. On another project, said Mr. Burkey, hollow tapered steel sections were driven and welded together to produce a pile that attained a total length of 178 ft.

J. S. Hancock (D. T. & I.) stated that when the use of H-section steel piles is contemplated, the precaution should be taken of driving a test pile in advance to determine how long the piles should be. Mr. Martens described an instance when the design of a structure was changed when it was found that a test pile had to be driven to a penetration of 91 ft. before a proper bearing was obtained.

The Elimination of Fire Hazards and the Maintenance of Fire-Protective Equipment

Committee Report

A FINE committee report on Practical Measures for the Protection of Bridges and Buildings Against Fire was adopted by this association in 1937 and covered the subject of fires in detail in so far as the B.&B. employee is concerned. The report of your present committee is intended, therefore, only to supplement the previous report.

Fire resistance of building construction varies in proportion to the susceptibility of the materials employed to damage by heat, and to the fire protection provided. The range extends all the way from the type of buildings so constructed that its contents may burn out completely, without danger of collapse or serious damage to its structural members, to the combustible type of building. Between these extremes lie modified types of construction, using first-retardant materials for structural parts and employing a division of building areas, with enclosures, to retard the spread of fires.

L. R. Morgan
Chairman

Fire-Retardant Wood

Wood treated with fire-retardant salts is becoming of greater interest to the railroad bridge and building designer and maintenance officers. Undewriters' Laboratories tests show that such wood contributes only from 15 to 20 per cent of the fuel consumed in a fire, while its flame-spreading quality is very low and the smoke developed is less than that of untreated lumber. In fires of great intensity, it has been found that timber treated with a fire-retardant can withstand long exposure to high temperatures because of the formation of a hard char that builds up on the exposed surfaces, protecting the inner layers of wood. Later, when the char is removed, the remaining wood can be reused.

Fire-retardant woods were rapidly coming into use on the railroads until interrupted by war-time requirements, and have been used extensively by the U. S. Navy. Plywood and laminated wood, as well as solid lumber, can be given this treatment, making it highly suitable for such structures as shops, enginehouses, tunnel linings, snowsheds, timber trestles, coaling stations and other structures subject to similar fire hazards. This wood can be used also at freight stations, because it can be painted successfully if the wood is dry and if any excess chemicals are removed from the surfaces before paint is applied.

Construction Features

Modern design is by far the most desirable when formulated from the standpoint of the anticipated severity of fire in a structure. However, in recent years, the lack of the most desirable materials for construction has brought about much non-resistive construction. Temporary work of all types has been necessary. In many cases this has created hazardous conditions within and about permanent fire-resistive structures, because fires of sufficient intensity and duration affect every known material of building construction.

The principal elements for fire-resistive construction include walls of masonry or reinforced concrete, and those with non-combustible framing of structural iron or steel, protected with fire-resistive materials. Other structural elements, such as floors, roofs and partitions, should be designed of proper materials and thicknesses to provide adequate resistive qualities.

Fire walls or fire partitions aid materially in confining fires to a small area. All stairways and elevator shafts should be enclosed. Fire doors at openings are desirable to retard the spread of fires by helping to localize them.

Even the most resistive of building materials will expand under heat of sufficient intensity. Consequently, all structural members should be protected by covering them with protective material to insulate them against a rise in temperatures which, by softening or expansion, would seriously impair, if not destroy, their strength and usefulness. This protection is important also in preventing the transmission of dangerous temperatures through walls and floors to other parts of buildings where additional combustibles may be ignited.

The contents of a structure may be extremely hazardous and, thereby, reduce the fire-resistive factors of the structure as a whole to a very low point. It is desirable, therefore, that sprinkler systems be installed in even fully fire-resistive buildings to assist in confining any fire to the smallest area possible. Naturally, a sprinkler system cannot be installed in every building constructed and main reliance must be placed upon

proper housekeeping by the employees, and upon their education in fire protection. A clean structure and alert employees reduce the fire hazard in every building, regardless of its construction.

Electrical Hazards

Faulty electrical installations or negligence in the maintenance of electrical wiring, connections or fixtures, may be responsible for the starting of fires. In many instances employees will string wires in the open without authorization to bring light or power to a more convenient location, and a new fire hazard may thus be introduced if the connections or installations are not made in accordance with approved practices. It should be kept in mind that all electrical installations should be made by a qualified electrician, or should be inspected by him if made by others.

The maintenance of existing electrical facilities is easily overlooked due to the general reliability and durability for which electrical products have become known. Yet, movable parts, such as switches, extension cords and plugs, may become worn and unsafe through constant use and cause fires, especially where sparks might ignite some volatile material. Buildings adjacent to tracks are subject to vibration from passing traffic, and the insulation coverings of old wires may be worn off through abrasion and allow the bare wires to come in contact. This may result in a "short", the generated heat or sparks from which will present a fire hazard. A short may be made inadvertantly by a nail used in repair or alteration work, so driven that it pierces the insulation of existing wires.

Good Housekeeping

Good housekeeping is the most effective means of fire prevention. This fact should be stressed and given principal attention at all times. During periods of intense activity, it is not always possible to maintain cleanliness on a level which can not be criticized, but it can be and should be taken care of at the end of each working shift. In other words, "Clean up your own mess. Don't leave it for the other fellow," is an excellent motto.

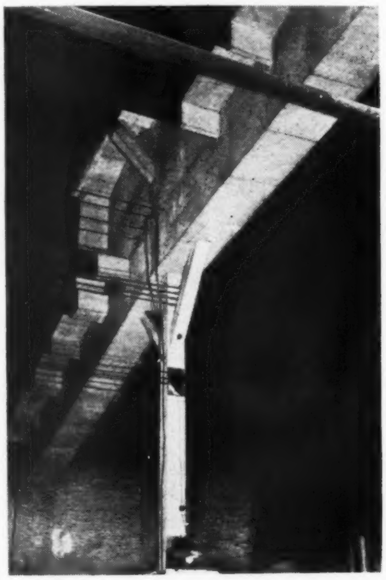
Housekeeping, carried on systematically, is not a burdensome task. If neglected, however, conditions will develop which will eventually require the interruption of operations for a general housecleaning. This is expensive and should be unnecessary. Following are a few suggestions in this regard:

(a) Send surplus material back to storerooms or stock piles.

(b) Dispose of scrap material and refuse before going off duty.

(c) Send back to the tool room, in a clean condition, tools that are not needed.

(c) Do not place discarded and surplus articles in corners, out-of-way places, under benches and tables, in boxes, drawers, lockers, cupboards and the like, or on lockers, benches, window ledges and other places where they will collect dirt and debris and be in the way of the sweeper.



Members of An Enginehouse Roof Boxed in With Asbestos-Cement Sheets to Form a Fire Curtain

(e) Put cleaning waste, rags, waste paper and other refuse in the receptacles provided for them.

(f) Do not hang clothing or other items on machines, piping, radiators and the like. Put them in their proper places in an orderly manner.

(g) If smoking is permitted, do not throw empty containers, cigarette butts, cigar stubs, pipe ashes, burnt matches and other refuse on floors.

Avoid Locker Room Hazards

Many lockers and cupboards are kept locked and, of necessity, it is the duty of the individuals using them to keep their interiors in a clean and orderly condition. Clothes should be hung up and not wadded or rolled and packed inside lockers. Oily clothes should not be put in lockers. Cleaning waste, rags and articles other than toilet accessories, should not be stored in lockers. Matches, other than "safety" matches, should not be kept in clothing or lockers. Lockers should be constructed of metal where possible, should be ventilated, should have slanting tops, and should be supported high enough above the floor to permit cleaning beneath them. They should not be placed along walls if this can be avoided. If placed against walls, the open spaces back of them should be closed tightly so that refuse cannot be accumulated there. These rules also apply to cupboards and cabinets of all descriptions.

Foremen should make an inspection of all lockers and cupboards at least once a month and take whatever action is necessary to have them kept clean, orderly and in good repair. Smoking should not be permitted in locker rooms, as there is always the possibility that pipes, with burning tobacco in them, may be placed in the lockers or clothing.

Officers, inspectors, supervisors and foremen should set an example for other employees by following good housekeeping practices and by obeying rules and signs posted for the information and guidance of employees. They should be careful not to do anything they would not want other employees to do. They should compliment employees on their housekeeping and other habits when they merit such action. At the same time, they should call to the attention of those who do not practice good housekeeping, or who do not obey rules and signs, the correct procedure, and should take corrective action when necessary.

Almost every employee takes pride in clean and orderly quarters if he feels that his efforts are appreciated by his superior officers. He will respond favorably to words of encouragement and commendation, and, when justly criticized, will co-operate in a measure surprising to anyone who has not already tried this method—but he will resent unjust criticism.

Fire-Fighting Apparatus

The sudden end of the war has resulted in sweeping changes in the availability of many types of fire-fighting apparatus, thereby making it difficult to prepare an accurate statement of the apparatus available at this time. Your committee, however, realizing that the availability of many types of improved fire-prevention apparatus will affect materially the selection of suitable equipment, presents this part of its report as an interim report of

progress, with the suggestion that it be revised subsequently and enlarged to include the use of new apparatus as it becomes available.

The amount, rate and method of application of the extinguishing liquid or other material to be provided for in any building for use in case of fire must be carefully considered, and may call for special engineering judgment, particularly in the case of important buildings requiring large-scale installations. The use of standard approved equipment is also of major importance.

The use of water as an extinguishing agent in the form of a spray or fog is more effective than the use of hose streams. Automatic sprinklers are also effective if water is applied to a body of flammable liquid which is heated above 250 deg. F. Yet, it must not be overlooked that the liquid may foam over and spread the fire.

Portable extinguishers of the foam type are suitable for the protection of small amounts of certain flammable liquids. A permanently-piped foam system is best for large-scale application.

Portable extinguishers of carbon dioxide, and dry chemical types are applicable to fires involving small quantities of flammable liquids. For large-scale protection, however, properly designed, permanently-piped carbon dioxide systems of suitable size are necessary.

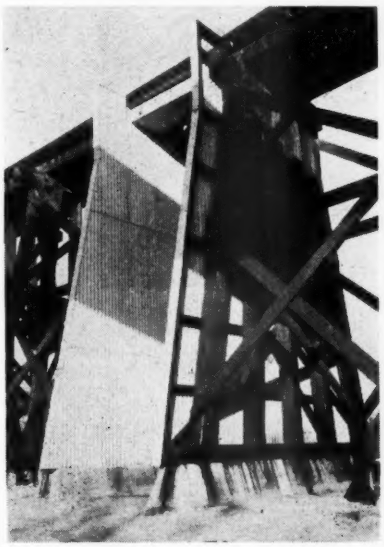
Gas fires may be extinguished by carbon dioxide or dry chemical extinguishers, and, in some instances, by a water spray. However, in such cases, it may be even more dangerous to attempt to extinguish the flame than to allow it to burn out, if the gas is allowed to continue to flow, because an explosive mixture may be formed with air, which, if ignited, might cause more damage than the fire itself. The best method of extinguishing gas fires is first to stop the flow of gas. To permit immediate access to valves to shut off the supply of gas, the use of carbon dioxide or dry chemical extinguishers may be desirable. But in many cases, it is best to allow the general fire to continue to burn, keeping the surroundings cool with water sprays to prevent the ignition of other combustible materials.

Inspection and Maintenance

First on any fire-prevention program is the proper inspection and maintenance of privately-owned fire-fighting apparatus, because there should be no uncertainty as to whether this equipment being in proper condition for immediate use when neeeded. Split seconds count, and because most conflagrations are small at the start, the ready availability of mechanically perfect equipment may mean the difference between slight damage and total loss.

Any fire-prevention plan which includes the inspection and maintenance of privately-owned fire-fighting apparatus must be thorough and follow a definite program. First, an inspector must be chosen who has the character necessary to accept his all-important responsibilities; who can be trusted; and who realizes the importance of his work. Secondly, the inspector must be instructed in all phases and types of fires, so that he will have a thorough understanding of the types of equipment necessary to control them. He must be instructed in the maintenance of the types of equipment in use and must understand how to make repairs.

Following the installation of the proper equipment in the proper place in and around buildings, structures, machinery, etc., the inspection of this equipment on a definite schedule is most important. Each piece of fire-fighting equipment should have an inspection card attached to or located alongside it, and which must provide space for the inspector to enter the date of his inspection and



Asbestos-Cement Sheets Form An Effective Fire Stop in This High Trestle

his signature. Printed on these cards should be the name, address and telephone number of the person responsible for the maintenance of the apparatus, as well as the equipment number, the name or number of the building in which located, and instructions to notify the responsible party immediately in case the equipment is used. Before affixing his signature to this card, the inspector must remove the equipment from its holder and make a thorough inspection of it, and, if an extinguisher, he must determine its condition by the test requisite to its type.

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The safe time limit for the inspection of equipment has been found to be 60 days, and all equipment should be inspected at least once during this period. In congested areas where the fire hazard is much greater than in outlying districts, a maximum of 30 days between inspection has been found to be good practice. Where water mains and hydrants are available, they should be tested and flushed every six months. Where hose houses are maintained for the storage of hose and apparatus, the use of seals to lock the doors on these buildings is highly recommended, with an inspection being made of these seals at least every seven days under normal conditions. If the area is extremely hazardous, a daily inspection should be made. Regardless of type, the recharging of fire extinguishers and the replacement of worn equipment must be accomplished by an inspection at least every 12 months.

For the effective handling of replacements and repairs, and the making of reports to his superiors, the inspector's records at his home office should include a card or record system showing the following information: Location of equipment by city, town or station; building name or number; number assigned to equipment; capacity; manufacturer's name; type and serial number of equipment; and any other information necessary to identify the individual piece of equipment.

Success in fire prevention depends on the development of an adequate detailed plan, and strict adherence to the regular scedule set up in that plan. This is fundamental to the adequate inspection and maintenance of fire-fighting apparatus.

The protection to be afforded buildings leased to outside parties should be governed by the nature of exposure to railroad property. Where an application for lease indicates exposure of major size, the application should be denied. Periodic inspections of leased properties should be made in the company of the lessee or his representative, to ascertain if all fire-protection equipment is in good order and to correct

undesirable housekeeping conditions.

In most cases the lessor has little to say regarding the operation of the lessee's business, and must depend on his co-operation to have undesirable conditions corrected. This can usually be accomplished by letter to the lessee, outlining conditions that need correction. In stubborn cases, cancellation of leases can be threatened, but usually this is not necessary.

Committee Personnel

L. R. Morgan (chairman), fire prev. eng., M.C., Detroit, Mich.; George W. Rear, Jr. (vice chairman), asst. gen. fire insp., S.P., San Francisco, Cal.; H. M. Church, gen. supvr. b. & b., C. & O., Richmond, Va.; R. E. Dove, managing editor, Ry. Eng. & Maint. Cyclo., Chicago; J. W. Martin, fire & tunnel insp., S.P., Sacramento, Cal.; C. E. Russell, supvr. w.s., I.C., Chicago; H. E. Skinner, br. insp., E.J. & E., Joliet, Ill.; C. R. Taggart, supvr. b. & b., C.C.C. & St. L., Indianapolis, Ind.; and B. M. Whitehouse, ch. fire insp., C. & N.W., Chicago.

Discussion

W. A. Huckstep (M. P.) raised a question regarding the use of soda-acid type fire extenguishers in enginehouses, pointing out that there are hazards involved in the use of such extinguishers, especially by persons unfamiliar with their operation. Chairman Morgan replied that the committee had not discussed this type of extinguisher since it is in such general use already, but he added that it is the practice on his road to familiarize the employees with its operation and the hazards involved.

Referring to the hazards of open wiring, F. H. Soothill (I. C.) stated that his road had been eliminating such wiring for 25 years through the use of conduits. Another point made by Mr. Soothill was that fire insurance rates can be minimized by maintaining buildings properly. Chairman Morgan stated that it is a practice on his road, where improvements are made in buildings, to bring them to the attention of the insurance brokers.

The Maintenance of Wood Bridges and Trestles

Committee Report

WOOD bridges and trestles are an American institution and a permanent one. The maintenance of these structures is a never-ending task, which requires a heavy outlay of labor and material. An "old timer" in bridge maintenance work was heard to say recently that in his many years experience he had not yet learned all that there is to do in bridge maintenance, but that he had learned considerable about what not to do. There are no short cuts to be found in this work; it is a full-time, highly specialized job.

The advent of high-speed trains and fast schedules, both passenger and freight, not only on main lines, but in many instances on secondary and branch lines as well, has perhaps changed somewhat the practices in bridge maintenance work followed 20 to 30 years ago; yet the fundamental requirements have not changed. Obviously, safety of traffic is a fundamental requirement regardless of train speed. A smooth-riding track is also a requirement which becomes more important as train speeds increase. Without question, high-speed trains demand that more frequent and more careful attention, both as to inspection and frequency of repairs, be given to bridges of all types of construction.

During the war it was necessary to modify somewhat the usual or standard practices formerly employed, because of the scarcity of material and shortage of man-power, with the result that much work was done that was neither economical nor desirable.

V. E. Engman
Chairman

Despite these handicaps, the bridge maintnance forces did a highly creditable job in keeping wood bridges and trestles in safe condition for war-time traffic.

Inspection

A preliminary and continuing function in connection with any good maintenance program is inspection work. The inspection of bridges must be done thoroughly and carefully. Attention must be given to each member to determine just what work needs to be done to maintain the bridges safely and economically. On most roads, the inspection for program work is made some time in advance of the time the work is to be done, generally the preceding season. The actual time of year the inspection is made, the make-up of the inspection party and the mode of transportation varies on different roads, but the technic employed to determine the condition of the timber is very much the same. Generally, the life of the piling or other sub-structure determines the life of the structure. The policy then, on most roads, is to carry wood bridges and trestles to the limit of safety, with a minimum of repair expense, and then renew them out-of-face or with a different type of structure. Repairs to the structure would consist of replacing individual posts, piles, sills, caps, braces, stringers, ties and guard timber. The inspection should determine the dividing line between economical repairs and renewal in kind or with a different structure. As a general rule most of the timber in a wood bridge fails through decay, and it takes sound judgment on the part of the inspector to determine when the timber has served its life. Many factors enter into this—climate, density of traffic, speed of trains and kind of motive power.

Work Sheet Program

From the annual inspection field notes a work sheet is made up on which is shown in detail what repair work is to be done and the material required for the work. Actual measurements should be made in the field so that material for repair work, insofar as possible, can be furnished pre-

framed. For heavy renewals or rebuilding, further surveys and studies may have to be made. All railroads have standard plans for their various kinds of wood bridges and trestles, and pre-framing of timber, both treated and untreated, is becoming standard practice on many roads.

After the work sheet is approved, a schedule or work program is made out. This program should be given considerable study so as to permit carrying out the work to the best advantage. Some jobs may have to be given preference, but other than that the work should be programmed from an economical standpoint. In climates where freezing occurs, from December to March, inclusive, and the work involves considerable ground excavation and work on ballast decks, the work should be programmed for the non-freezing months. On some lines the density of traffic is lighter in certain seasons, and should be taken advantage of. In some cases certain classes of work may have to be done on Sundays or at night. On some lines the transportation of outfit cars is a problem, and should be given consideration in making out the program.

Planning the Work

On main lines, bridge maintenance work must be caried on without delaying the movement of traffic, and with the avoidance of slow orders whereever possible. Obviously, this increases the cost of the work, which must be so planned that whatever is undertaken can be finished, and the bridge restored for normal train speed, between trains. There are, of course, exceptions, where the work is of such nature that the speed of trains must be restricted over the bridge, but this restriction should be of the shortest possible duration. In some cases it may be advisable to double up two or more bridge crews, or increase the number of men in the crew temporarily, to get certain work done in a limited time. In multiple-track territory, there may be some time during the day when traffic can be detoured without interfering with train schedules, and one track taken out of service for a specified period in order to get some specific job done.

The work must also be planned for the safety of the structure, as well as for the men doing the work. This responsibility rests first with the supervisor, and then directly on the foreman in charge of the crew. Nearly every operation in connection with the repair or renewal of a bridge makes the track impassable, and too much emphasis cannot be placed on the necessity of employing qualified flagmen to protect the work. Especially under the present man-power shortage the temptation may be strong to take a chance and to do a certain job without flag protection.

Force and Equipment

With few exceptions bridge repair and renewal work is done by company forces. The bridge crew usually includes a foreman and from 10 to 16 men. Ten men and a foreman are considered the minimum force for a well-organized bridge crew on ordinary repair and renewal work. The men are generally housed in outfit cars consisting of the required number of bunk cars, kitchen and dining cars or combination kitchen and dining car, tool cars, equipment cars, and material cars. The camp is located at the siding nearest to the work, providing food supplies and water are obtainable at that point.

The transportation of the men between the camp and the work site is generally by track motor cars and trailers where the number of men requires them. In recent years, where highways parallel the tracks, and particularly at the larger terminals, many roads have provided highway trucks to handle men and material. A hand derrick mounted on a push car for handling material at the bridge is now standard equipment on many roads. The newer designs have a derrick with a 360-deg. turn, an adjustable boom to various radii, and a single load line to a light, safe winch of sufficient capacity to handle the largest timber used in a bridge. The entire assembly is light enough so that it can be removed from and replaced on the track readily. This push-car derrick is considered one of the most practical pieces of equipment available to facilitate work on timber bridges and to save heavy lifting by the

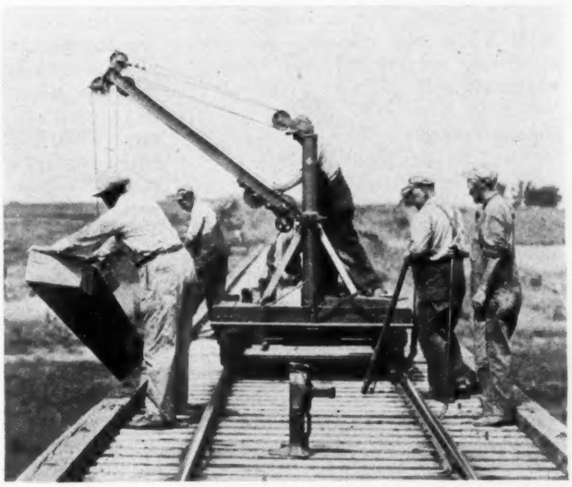
B. & B. SECTION

bridgemen. By using a heavy-duty motor car to move it back and forth, the push-car derrick will, in many cases, serve the same purpose as a self-propelled crane. The locomotive crane has, of course, its place on large jobs. Off-track caterpillar cranes can be used advantageously on some work. Likewise, cranes mounted on scows, to work from water, have a place in some classes of work requiring the lifting of heavy material.

Tools

The use of power-operated tools does not seem to be universal. The reason for this may be that, in the past, the power units available for operating power tools were quite heavy and required considerable effort to get them to and from the job. As a result, they were generally used only on the larger jobs. A new development is a gasoline-operated generator weighing less than 200 lb., which will furnish enough power to operate a chain saw. Other power tools that can be operated by this unit include a circular saw, boring machine and power wrench. This unit is of such size and weight that it can be carried on the motor car trailer along with the other tools, and used on all jobs, regardless of size, where sawing, boring or bolting are required. One advantage of an electric power unit is that it will furnish light for night work.

Power tools are labor-savers wherever used. Many crews are equipped with flame-cutting torches for cutting off old bolts, and this equipment also saves labor in other applications. In



The Push-Car Derrick With Hand Hoist Is Being Found Valuable on Many Bridge Jobs

the hand tools used by bridgemen, we can expect developments in the lighter and more durable materials brought about by experiment and research during the war. An important tool is the jack, and it is the heaviest tool that has to be handled. A jack that has come into favor for bridge work in recent years is the hydraulic jack. This type is obtainable in various capacities but for bridge work one of 20-ton capacity is especially popular. The advantage of a hydraulic jack is its compactness, and the ease and safety with which it can be operated.

Repair Work

A bridge is considered in two sections—the substructure, including the bents, consisting of piles, or of posts on wood, stone or concrete; one or more sills; braces, struts and caps. The superstructure consists of the stringers, ties and guard timbers on open-deck bridges, and the stringers, ballast retaining timbers and deck boards on ballasted-deck bridges. Usually, the substructure causes the most concern. The bents are subject to damage by ice, by debris carried in flood water, and by undermining by flood water, in addition to destruction by termites, carpenter ants, marine borers and other bugs, insects and worms. Because of uneven bearing, and of original defects in the timber, such as concealed knots, cross grain, etc., the posts, sills and caps may split and break. Piles decay at the ground line, at the top and under braces. Failures occur in creosoted piles and timber cut or bored in the field, where the exposed untreated wood was not treated with creosote when originally placed.

Superstructure

The superstructure is not subjected to the same hardships as the substructure. The stringers, if designed originally with sufficient section, rarely break unless there is a failure in some portion of the substructure to create an uneven hearing, or unless they were below sound grade when installed. The same holds true with the ties. As a general rule, all of the timber in a structure decays or becomes of age at about the same time. However, in every type of construction there are individual pieces that decay or fail more rapidly than the rest of the timber, and these are the pieces that must be replaced currently. Thus, the importance of frequent, thorough and detailed inspections of the bridge members, as mentioned previously, can be readily seen.

When individual piles become weakened beyond their intended capacity, the usual method is to excavate and cut off the pile at sound timber, replacing the part removed with a part pile or with sawed timber, and anchoring the bottom of the new piece to the pile in the ground by toe nailing with heavy spikes or drift bolts. The top is anchored to the cap in the same manner as the original pile. For a high bent where the pile above the ground is sound, the decayed portion of the pile is cut out and a stub inserted. In addition to toe nailing, the stub is boxed to prevent buckling. On high-speed, heavy-traffic lines, experience dictates that not more than two piles in any one bent be treated in this manner. Where more than two piles are involved, all of the piles should be cut off and a framed bent installed, or part of the piles redriven. The following rules may be used as a guide:

(a) For bents under 15 ft. high (base of rail to ground), when bridge is on tangent, piles should be stubbed; when over 15 ft. high the outside piles should be redriven and the inside ones stubbed or spliced.

(b) For bents under 12 ft. high (base of rail to ground), when bridge is on a curve, piles should be stubbed; when over 12 ft. high the outside piles should be redriven and the inside ones stubbed or spliced.

(c) Bents over 20 ft. high (base of rail to ground), on tangent or curve, should have at least three whole piles (generally both outside piles and one inside pile), and the others may be stubbed or spliced.

Where piles are decayed at the top, a good practice is to cut them off 14 in. to 20 in., as required, to get to sound timber, and then double cap. On light-traffic lines individual piles may be blocked. The sawed post in a trestle lends itself more readily to replacement or blocking than piles. The decay is usually at the bottom where the post contacts the sill, and where one or two posts are involved the decayed portion is cut off and a block installed. Where more than two posts require attention, all of the posts are cut off and a second sill is installed. Where individual caps, sills, braces or struts have become weakened beyond their ability to perform their intended function, there is only one remedy—renew them.

Renewals

To renew an intermediate sill is a big job, and consideration could be given to bolting splices from the bottom of the upper post to the top of the lower post and by-pass the sill. The renewal of individual stringers is a slow and costly procedure. A better practice is to install an additional stringer inside or outside of the chord to aid the weak member. In replacing individual ties, care should be taken to install ties of the same height as the adjoining ties, so as not to disturb the smoothness of the track.

During the lean years prior to the war, and throughout the war with its limitation on the supply of timber, we have become second-hand-timber conscious. Second-hand timber has been used for every conceivable purpose, and, no doubt, we will be compelled to continue the use of every piece of second-hand timber that becomes available. In renewing a bridge much timber is recovered that has a life expectancy of many years, and that thus can be used for routine bridge repair work, saving new timber. This matter should be given consideration when making out the bridge repair and renewal program.

Committee Personnel

V. E. Engman (chairman), ch. carp., C. M. St. P. & P., Savanna, Ill.; A. E. Bechtelheimer (vice-chairman), engr. br., C. & N. W., Chicago; L. K. Arnold, div. br. insp., A. T. & S. F., San Bernardino, Cal.; G. W. Benson, supvr. b. & b., C. of Ga., Macon, Ga.; L. G. Byrd, supvr. b. & b., M. P., Poplar Bluff, Mo.; G. S. Crites, div. engr., B. & O., Baltimore, Md.; Carl M. Eichenlaub, res. engr., San Diego & Ariz. East., San Diego, Cal.; C. F. Gilbert, supvr. b. & b., C. & O., Peru, Ind.; J. E. Hogan, asst. div. engr., C. & O., Hinton, W. Va.; V. W. Hutchings, supvr. b. & b., S. P., Bakersfield, Cal.; Sam Lincoln, gen. fore. b. & b. (retired), A. T. & S. F., Galveston, Tex.; G. A. Linn, supt. b. & b., C. & N. W., Boone, Iowa; Norman F. Podas, ch. engr., Minnesota Transfer, St. Paul, Minn.; W. Walkden, br. engr., C. N. R. (retired), Winnipeg, Man.; and J. W. Welch., supvr. b. & b., F. E. C., St. Augustine, Fla.

Discussion

F. R. Spofford (B. & M.) opened the discussion following the presentation of this report by describing the practice of determining renewals of wood bridges and trestles adopted by his road during depression years, which is still in use. He said that the decision as to what members or portions of a wood bridge should be renewed during the year is made by the supervisor of bridges and buildings. Such decisions are checked by the bridge engineer and are based on the reports of the bridge inspectors, which must be submitted in great detail. By the use of detailed reports, which are frequently checked in the field, he added, some structures have been carried over for a number of years.

J. S. Hancock (D.T.& I.) inquired whether any roads use anything besides timber for trestle backwalls, to which Chairman Engman replied that most roads used creosoted timber, but that pre-cast concrete slabs have been used in some cases.

What's the ANSWER?

Benefits from Transposing Rail

What are the advantages of transposing rails on curves, compared with regaging? The disadvantages? Why? Does the weight of the rail or the degree of curvature make any difference? The density or speed of traffic?

Regaging Mutilates Ties

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

Regaging is an operation that mutilates ties and consumes labor without added benefits to the track structure, other than that of bringing the rails back to gage. On the other hand, transposing the rails on curves avoids spike cutting and other mutilating effects on the ties, and goes still further than this in that it adds greatly to the life of both the outside and inside rails.

On a curve somewhat sharper than 10 deg. on a heavy-traffic line, three times the life of the rail was obtained by transposing it, compared with regaging, and the life of the ties was also increased materially. This rail was of the 130-lb. section, and when the outer rail was worn to the point where the gage was ¾ in. wide it was transposed, without turning, to the low side of the curve. This rail was cold rolled and smooth but still had enough head to withstand pressure stresses and to hold sand. If the head had been too thin there would have been a likelihood of corrugations.

The rail from the low side of the curve was turned end for end and laid on the high side. Although the running surface of this rail was a little rough and there was a bead on the gage side as it was relaid, these imperfections caused no trouble and soon wore smooth. The long life of this rail resulted from the cold-rolled surface, as well as because there was no trough in the head of the low rail to catch grit and prevent free adjustment of the wheels.

In transposing rails having the usual amount of allowable head wear, there should be no reason for disturbing the tie plates or for shifting them from their well-seated positions, as is necessary when resorting to regaging. This is an item of still more importance where hold-down spikes are used as independent fastenings.

Where traffic is not too dense and the roadbed will permit, a locomotive crane can shift the high rail across the track to the low side progressively and also turn the low rail end for end and set it on the high side for the track gang. About as much track can be completed in a given time as is covered in the same time when regaging. If traffic is too dense or the roadbed will not permit the rails to be turned on the spot, high-side rails of similar wear can be taken from some other curve and laid on the low side, and the low rail can then be turned and laid in the curve from which it was taken or in some other.

Saves Spike Killing

By E. Bennett
Chief Engineer Maintenance of Way and Structures, Southern Knoxville, Tenn.

There are definite advantages in transposing curve-worn rails, of the same section and weight, from the high or outside of curves to the low or inside, instead of regaging, especially where the tie plates are held to the ties by fastenings independent of those holding the rail. This will prevent unnecessary spiking, which results in damage to the timber. Curves that are maintained with correct tie-plate gage and bearing can be relaid by using this method more economically in material handled and in the labor required to make the change.

Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered in January

1. *To what extent does drainage affect the life of ties? In what ways?*
2. *Should the floor of a passenger station be flush with the platform or raised above it? Why? If the latter, how much? What are the considerations?*
3. *What advantages, if any, are there in organizing special gangs for renewing turnouts, including slip switches, in large yards and busy terminals? What disadvantages?*
4. *Is a pile hammer suitable for driving concrete or steel piles also suitable for driving wood piles, and vice versa? Why? Does the length or spacing of the piles or the character of the soil make any difference? In what way?*
5. *What changes in methods of maintaining track have been necessary by reason of higher train speeds? What has been the effect of increased traffic?*
6. *What are the advantages of roofs on water tanks? The disadvantages?*
7. *Should special maintainers be employed to service and maintain rail and flange lubricators? Why? To whom should they report? If not, what method should be employed? What are the advantages?*
8. *What effective method can be employed to protect the concrete in cinder pits against damage from heat?*

Curve-worn rails that are moved from the high to the low side of the curve have the added advantage of reducing friction and will usually wear to the regaging life of the replaced outside rail, unless curve lubrication is installed, in which case the inside rails may require replacement before the outside rails are worn sufficiently to require regaging, and this replacement may be made with released rail that is selected and held for this purpose.

Neither the weight of the rail nor the degree of the curve, within usual main-track alinement conditions, makes any difference. This method of maintaining curves by transposing curve-worn rails is readily adapted for any speed or density of traffic.

When Burning the Right of Way

What precautions should be observed when burning the right of way? In what ways is this affected by the character of the adjacent land?

Depends on Exposure

By T. M. Pittman
Division Engineer, Illinois Central, Memphis, Tenn.

The degree of care that should be exercised to prevent damage as a result of burning the right of way will depend in large measure upon the degree and character of the exposure, both on the right of way and on the adjacent property. In rare locations, practically no precautions are needed, for the fire will burn itself out without causing any damage, but it is generally necessary to exercise a variety of precautions, ranging from grassing around telegraph poles to plowing furrows for fire breaks along fences, or even to providing water facilities for extinguishing the fire.

Damage to railway property is most likely to occur in the burning of telegraph poles, right-of-way fences, bridges, buildings and piles of material that have been grassed carelessly. Damage to outside property generally is to hay fields, meadows, small grain standing in shocks, out buildings, timber and ornamental trees and shrubs. There are records where fires have traveled several miles across fields and through woods and burned cabins with loss of lives.

While the men in charge of controlling the fire must take such precautions as the immedate conditions require, some general practices will assist in this control and make emergency measures less likely to be needed. Among these, the grass should not be burned during a high wind, and a time should be selected when there is a moderate or low velocity wind blowing toward the track. If the grass is very dry and heavy, so that the flames will be high, the fire should be started early in the morning while the grass is still damp with dew.

Again, the area to be burned should be commensurate with the size of the gang, so that the fire can be brought under control in the event the wind changes direction and threatens to carry the fire to adjacent property. Telegraph poles, bridges, buildings, stacked ties and other materials should be grassed around a sufficient distance to insure that the fire will not jump from the grass to the poles, structures or materials. Additional precautions should be taken where creosoted material is involved. If the adjacent property is especially valuable and of a highly flammable character, several furrows should be plowed along the fence for a fire break.

Before starting the burning, the men should be provided with facilities for putting out the fire. Wet burlap bags wired to short handles, or evergreen boughs, such as pine or cedar, are quite effective in whipping out fires, and barrels of water on push cars should be provided to wet the sacks and to extinguish flaming telegraph poles or other structures that become ignited.

Dirt thrown against flaming poles, piles or other timber will extinguish the flame, but unless the embers are extinguished also, they may continue to burn into the pole or they may be whipped into flame by a light wind. All sparks that might smoulder and later flame up after quitting time should be extinguished completely to prevent sparks being fanned into flame or blown into unburned areas.

Many Things to Consider

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

Prior to the advent of weed burners it was the practice to clear fire strips along the right-of-way line, and in some instances similar fire breaks were cleared outside the right of way and the right of way was then burned by back firing from these strips toward the tracks. To do this it was necessary to take into consideration the direction of the wind and its velocity; the chances that rolling embers might carry the fire out of bounds; the possibility that the fire on the right of way might jump the fire breaks; and other matters of purely local character.

It was considered that the best practice was to start the fire over such an area only as might be extinguished quickly by the force and with the equipment available. It was also the practice to do as much of the burning as possible by back firing. If the right of way was on a steep hillside at any point, it was folly to start the fires alongside the track and let them burn to the fire strips, as in such cases there was probably no means available that would prevent the fire from jumping the fire break.

Where modern weed burners are employed for burning the right of way, when the track area is burned, all of the precautions that were taken when hand burning was resorted to must be taken and, in addition, fire-fighting equipment in the form of water pumps or chemicals must be available. Besides these items, the direction of the wind and the topography of the adjoining land must be given consideration to insure that disastrous grass or forest fires are not started.

Should Do a Clean Job

By S. H. Shepley
Track Supervisor, Elgin, Joliet & Eastern, Joliet, Ill.

Obviously, there is a three-fold purpose in burning the right of way—to remove the unsightly appearance of the unburned vegetation; to remove excess weed growth in cuts, since high weeds act as a snow break, causing drifts to cover the tracks; and to remove a possible fire hazard. For these reasons, the burning of the weeds should be done in such manner that a clean job results, without danger to buildings, other structures, telegraph, telephone and signal poles and fences, and so that the fire will not escape to adjacent land.

To accomplish these purposes, the vegetation should be sufficiently dry to burn clean. The fall season, after the first heavy frost, is usually the ideal time, unless there has been an unusually dry summer and the weeds and grasses have dried prematurely. This period fits in nicely with the conditions that have confronted us

for several years, in that track maintenance tasks have not tapered off until frost, and, hence, few man-hours have been available for burning the right of way until after frosts begin.

If the right of way is to be burned safely and completely, close attention must be paid to the direction and velocity of the wind and to the number of men available to keep the fire under control. To protect structures and pole lines, scuffling around all posts, poles and structures is required as a part of the preparation for burning. The right-of-way fences can usually be protected by starting the fire at the fence line when the wind is blowing toward the track.

Where there is a thick growth of grass and high weeds it is advisable to start a back fire on the track side to prevent the fire from jumping across the track and getting out of bounds. However, where this does occur it is usually because too large an area was set on fire at one time; the wind was too high; or the force was insufficient to control the fire once that it was started.

The character of the adjacent land has an important bearing on both the preparatory work preceding the burning and the precautions that must follow the lighting of the fire. In many instances valuable crops are being raised immediately adjacent to the right of way and, where this is the case, the property owner should be asked to plow a fire guard on his property. If grain is shocked near to the right of way, the first two rows should be removed well away from the fence. These precautions are equally advisable to stop fires that may be started from locomotive sparks or that may have obscure origins.

Causes of Personal Injuries

What are the principal causes of personal injuries to bridge and building men? How can they be reduced?

Must Enforce Rules

By General Inspector of Buildings

As a result of many years of experience and observation, I am convinced that the great majority of accidents, not only among bridge and building men, but among those doing other classes of work, spring directly from carelessness. This may have been on the part of the victim himself, but is as often on the part of some fellow workman. Carelessness itself may have any one of several origins, among them inattention, absentmindedness, indifference, ignorance of the result of an action and ignorance of the correct action to take in both routine and unusual situations.

However, where one finds a record of personal injuries in any gang, he can be almost certain that it is the result of lax enforcement of safety rules on the part of the foreman. If this is the case, a little further search will usually disclose a marked indifference to safety regulations on the part of the supervisor and the trouble may also ramify to the division officers.

There is only one remedy for a situation such as this—the management must insist on the observance of safety rules. Provision must be made to educate supervisory officers to the importance of this enforcement and get them to understand that no excuse will be accepted for laxity in their enforcement. No man who is in position to enforce them should be overlooked, including regional, division and district officers, as well as the foremen who must assume most of the responsibility for educating the men in their gangs. In other words, to insure the success of safety work, every man who is even remotely responsible for safety matters must be safety minded and enthusiastic with respect to the prevention of personal injuries.

While pressure on the supervisor or the foreman, or both, may be needed to key them up to a full understanding of their responsibilities in safety work, enthusiasm for the work will be lacking and the effort will be ineffective unless they are given ample support in their educational work and all of the assistance that is needed to keep the effort going. Continued pressure, unless accompanied by support and assistance, never accomplished very much and is never likely to do so.

Needs Personal Contact

By Division Engineer

Safety is primarily a matter of education, and personal contact between the teacher and the man who is being taught is essential to the success of any educational work. While the inspiration for education in safety and for the enforcement of safety rules must come from the top, the burden of making the men safety minded can be most successful only when the gang foremen are enthusiastic proponents of safety and make their men understand that this is so, while educating them to what action to take and what actions to avoid in the situations that are constantly arising in their daily tasks.

The foreman who can do this has few accidents, compared with those who are indifferent, or who lack the ability to arouse their men to the importance of alert attention throughout the day's work, day after day and week after week.

A foreman who is a success in any phase of his work must have enough personality to impress his men with his ability and to cause them to respect him. He must be a leader and, if he is, he will be able to get, not more work, although he will probably do this, but greater efficiency from his men. It must not be overlooked that efficiency and low-injury rates go together, while inefficiency is almost invariably accompanied by a high accident rate.

Obviously, new men should be given more attention than the older ones, but this does not mean that the older members of the gang should be passed over in the matter of constant instruction. It has often been observed that the older and more experienced men have a higher rate of personal injuries than the younger and less experienced ones do. This has been accounted for in various ways, but many have observed that in giving close attention to the instruction of the newer employees, the older ones have been neglected to some extent. An excellent antidote for this situation is to ask some or all of the experienced men to watch the less experienced workmen and call their attention to breaches of safety rules, as well as illustrate to them concretely the correct action to be taken in such situations as those in which the breaches occurred. This will keep their minds on safety practices and thus deter them from making the same errors through carelessness or absentmindedness.

Safety instruction is one of the cases where the old adage "Physician cure thyself" applies with special force. Safety instruction should be given by both precept and example, and the foreman should never take any action that he has instructed his men not to take, or break any rule that he has endeavored to teach them to respect and obey. Months of conscientious effort may be annulled in a few minutes of careless or deliberate violation of the principles that have been taught so carefully.

Team work is one of the essentials

of a good safety record for any gang. This is particularly true in the handling of large heavy timbers, which falls to the lot of almost all bridge and building gangs, whether the timbers are being unloaded or are being applied in some structure. A dependable foreman organizes his gang for these particular tasks and satisfies himself that every man understands what is to be done and the part he is to play in the overall task. It is also important that the foreman always be present to direct and to know that the tools and tackle that are to be used are in first-class condition. The foreman who is himself safety minded and alert, will be able to communicate his feeling to his men and the accident rate of the gang will be reduced to the minimum.

I desire to qualify the foregoing statements, however, by saying that it is practically an impossibility to lay down cut and dried rules for applying anti-creepers, because every situation has some points that differ from every other one, for example, heavier traffic in one direction than in the other, or loaded cars moving in one direction with a preponderance of empties moving in the opposite direction, which may be either seasonal or continuous throughout the year. Grade conditions may also have an effect on the method of applying the anti-creepers.

How To Apply Anti-Creepers

What are the island and boxing method of applying anti-creepers? What are its advantages? The disadvantages?

Methods Are Different

By Geo. M. O'Rourke
Assistant Engineer Maintenance of Way, Illinois Central, Chicago

The boxing method of applying anti-creepers is that of placing anchors on opposite sides of a tie, as opposed to anchoring in one direction on one tie and in the opposite direction on an adjacent tie. The boxing method can be employed to equal advantage with the island method or when the anti-creepers are distributed evenly throughout the panel. The only advantage of the boxing method is that twice the number of anti-creepers can be applied as with the conventional method. A somewhat serious disadvantage of this method is that a very small movement of the rail results in movement of the boxed tie and, after a period of time, the track begins to churn as a result of the water that is held next to the tie.

The island method of applying anti-creepers consists of anchoring a certain number of panels and then leaving a certain number of panels unanchored. The anti-creepers in this case may or may not box the ties. The only advantage in this method is a reduction in the number of anchors. A disadvantage is that the rail has a tendency to run to anchored panels.

Has Been Successful

By General Roadmaster

It is my understanding that the island method of applying anti-creepers is to anchor all of the ties for a few rail lengths and then skip several rail lengths, perhaps as much as 1,000 to 1,500 ft., and then anchor another such island. I have never anchored track in this manner, but have seen one or two such installations. My observation is that it is difficult to obtain or control a uniform expansion between the rails between these islands, and for this reason this method is quite objectionable.

As to the boxing method—it is my understanding that this method consists of anchoring a uniform number of consecutive ties in both directions in each rail length. These installations are made on single track and on multiple tracks that carry trains in both directions. We have carried out this type of anchoring on our road, and in many instances the practice has been successful.

On a stable roadbed where wave action of the rail under passing trains is at the minimum, this method has merit. However, on a roadbed that is not stable, such as over swampy or other soft material ground conditions, where the wave motion of the rail is aggravated, the consecutive ties anchored in this manner show a tendency to work back and forth. As they do this they develop low spots and tend to create choppy-riding track under passenger trains.

Based on my own experience, I have reached the conclusion that the best method of anchoring track that handles traffic in both directions is to anchor alternate ties in both directions so far as the number of anti-creepers available will permit.

It must be kept in mind in this connection that the anti-creepers placed against any tie give only the resistance of the ballast in the cribs to the next tie that is anchored. If, therefore, every tie is anchored, one gets only the resistance of the ballast in the crib between the anchored tie and the next tie. On the other hand, by applying anti-creepers to alternate ties only, one gets the resistance of the ballast in two cribs. For this reason, I believe that the anchoring of every other tie in both directions on single track is superior to either the island or the boxing method.

Terms Are Confusing

By Track Supervisor

The terms used to designate the various methods of applying anti-creepers are somewhat confusing to the average trackman. To make myself clear, therefore, I shall call the bunching of the anchors on a group of ties, with an interval containing no anti-creepers, the island method. I shall also designate the application of anti-creepers to opposite sides of a tie as the boxing method.

Anti-creepers are applied to the rail for one purpose only, that is, to prevent longitudinal movement of the rail and thus preserve the expansion gaps that are watched so carefully when the rail is laid. But an inspection of almost any line of old rail or of even newly-laid rail will disclose that there must exist a marvelous belief among trackmen that by just hanging the anti-creepers on the rail the purpose for which they were purchased will be accomplished in some mysterious manner.

It does not speak too highly for the men engaged in track maintenance that in all of the years since they began to use anti-creepers they have never developed a real method of applying them in such manner that they will remain effective. In other words, curiosity and imagination about and supervision over this important detail have been lamentably weak.

Generally, to be fully effective, the rail must be restrained from creeping movements in both directions, even upon multiple tracks. It has been found by experience that just scattering the anti-creepers throughout the rail length is not sufficient, so that various methods of distributing them have been resorted to in an effort to hold the rail without movement. There is only one way in which this can be done surely, this being by two-direction anchorages on every tie. Where this is done, each panel of the track absorbs its strains independently of all other panels.

Welded Versus Riveted Tanks

What are the advantages of welded compared with riveted tanks for water treatment and storage? The disadvantages?

They Cost Less

By A. W. Johnson
Steam Heat and Water Service Engineer, Atchison, Topeka & Santa Fe, Topeka, Kan.

Among the advantages of welded compared with riveted construction for water tanks, are lower first cost and the elimination of leaks at joints and around rivets. Furthermore, welded pipe connections can go through the tank shell instead of it being necessary to place them on radial lines, as must be done in the riveted construction. This makes a far more satisfactory piping arrangement in tanks and frost boxes than when on radial lines.

The dismantling of a welded tank will be simpler and can be accomplished at less cost, while the result will be more satisfactory when it is re-erected. Again, the cleaning and painting of a welded tank is easier and less expensive than the same work done on a riveted tank.

Difficult to Compare

By Engineer of Water Service

It is only within the last 10 years or so that welding has been applied to the construction of steel tanks in railway water service. Prior to this time all steel tanks were riveted. Because there are so few welded tanks in service, added to the fact that they have been used for so limited a time compared with the riveted tank, it is difficult to make a comparison based on service records. It is apparent, however, from the somewhat limited experience with the welded tanks that have been constructed, that they are giving satisfactory service, and they appear to be gaining rapidly in favor.

Conditions growing out of the demand for steel in the present war greatly restricted the use of steel for civilian purposes and thus practically prohibited the construction of steel tanks for railway water service. As these restrictions are removed, welded tanks will probably be constructed in increasing numbers, especially those of the standpipe and flat-bottom type.

Among the apparent advantages of the welded over the riveted tank are (1) lower cost of construction. However, no definite or reliable figures are available as to the comparative cost of riveted and welded tanks, primarily because of constantly increasing costs. It has been estimated that the cost of an all-welded, standpipe-type, flat-bottom tank is approximately 20 per cent less than that of a riveted tank of the same size and design. In all probability, the same ratio of cost can be applied to tanks of other designs, since the saving in welding is largely reflected in the labor costs. (2) There is less probability of leakage, since welded tanks require no calking, and there is no possibility of leakage at seams as with riveted tanks. (3) Welded tanks have greater strength, since there is no loss of metal as there is in punching or drilling for rivet holes. (4) Because of their smoother surface and freedom from leakage, as well as because there are no lapped sheets or rivet heads, welded tanks are easier to clean and paint.

So far, no disadvantages have developed in welded tanks and none are foreseen. All welding should be done in accordance with the specifications for welded steel tanks for railway water service, as adopted by the A.R.E.A. in 1944.

Requirements for a Tie Plate

What are the essential requirements for a tie plate? Can tie-plate design be standardized? Why?

Too Many Designs

By J. de N. Macomb
Assistant to Vice-President, Inland Steel Company, Chicago

The purpose of a tie plate is to transmit and distribute to the tie the load that is received from the rail, for the dual purpose of protecting the tie and of resisting the tendency of the rails to spread. To accomplish these purposes the tie plate should be of such material and thickness as to possess the necessary stiffness and strength to distribute the load.

In general, the larger tie plates are used with the heavier rail sections, and larger plates are used with softwood rather than with hardwood ties. Twelve and 14-in. tie plates are used with the 131-lb. rail section, which has a base 6 in. wide, and 11 and 12-in. plates are used with 112-lb. rail, which has a base width of 5½ in. Double-shoulder tie plates are also generally used with rails having a 5½-in. or wider base, while the single-shoulder type is used with lighter rail sections.

The load imposed by cars and locomotives is applied to the rail in an outward as well as a downward direction, creating a tendency for the rail to roll outward. This tendency is resisted in part by the practice of using a tie plate with a rail seat canted approximately 1:40, and partly by placing the shoulders eccentrically with the length of the plate. The appropriate eccentricity differs with different track conditions and an approximation is the best that can be hoped for in determining the amount of eccentricity. For this reason, the distance from the face of the field shoulder to the field end is usually greater than the distance from the gage shoulder to the gage end of the plate.

As the load is applied over the area of the rail seat only, whereas the support is assumed to extend over the whole area of the tie plate, and with a cant of approximately 1:40, the greatest stress in the plate occurs near the field shoulder and the thickness at that point is calculated to resist this stress.

From the base of each shoulder to points near the ends of the tie plate, the stress diminishes to zero. However, the ends of the tie plate are given a thickness, in the case of small plates, of about one-half the thickness at the field shoulder. This ratio may be decreased in the case of large tie plates. Where screw hold-down spikes are applied, the ends of the tie plates are made flat to engage the undersides of the heads of the screw spikes.

The rail seat may be flat in the direction of the shoulders or it may be given a circular crown, the object of which is to hold the bearing of the rail near the middle of the tie plate. Recent investigations by the research department of the A.A.R. indicate that this design increases the stresses in the base and lower portion of the web of the rail. The beveled crown tie plate restricts the bearing of the rail within limits without setting up localized stresses in the base.

The bottom of the tie plate may be flat or provided with two rounded ribs, while many other designs for

the bottom have been used. Where two ribs are employed, they should be placed in definite positions with respect to the faces of the shoulders. The width of the tie plate is limited by the width of the face of the tie and usually ranges from 7 to 8 in., 7¾ in. being used for the larger A.R.E.A. designs.

Tie plates are punched for spiking, four holes usually being provided for the rail spikes, two through each shoulder. In the larger designs, two to four additional holes are punched near the ends of the plates for hold-down spikes.

Standardization can be accomplished in large measure. To meet the needs of the railways, tie plates canted approximately 1:40, with no crown, but with inclined ends and flat bottoms, must be available for use with rails having different widths of base. For rails of 100-lb. and heavier, double-shoulder designs are generally used, and the positions of the shoulders must correspond with the widths of the rail bases. For this reason, double-shoulder plates must be supplied for use with rail bases of the following widths: 5½, 6, 6¼ and 6¾ in. For rails lighter than 100 lb., single-shoulder plates should be available for use with rails having two or three narrower widths. For each of these widths of rail base, plates of two or three lengths should be available, and a few sections with the following characteristics can be retained: canted approximately 1:20; no cant; rolled crown; flat ends; and two ribs on the bottom.

While designs meeting the foregoing conditions comprise an extensive list, the number thus represented is still a far cry from the more than 300 different designs for which the steel mills must now carry production equipment. Conferences between representatives of the railways and the manufacturers are now under way looking toward a limited number of tie-plate designs which will meet the needs of the railways and at the same time relieve the manufacturers from some of the burden under which they are now laboring.

Can Be Standardized

By A. Drager

Maintenance of Way Storekeeper, Central of New Jersey, Jersey City, N. J.

Tie plates are designed for a twofold purpose, namely, to protect the tie from mechanical damage, principally abrasion, and to hold the rails to gage. To accomplish these purposes, they should be of sufficient area to distribute the wheel loads to the ties and thus reduce the unit load on the wood. The bottoms of the plates should be flat. Corrugated or ribbed bottoms compress and cut into the wood fibres, so that water gets under the plates and remains to soften the fibres and encourage decay. The plate should have a thickness that will make the plate stiff so that it will withstand bending stresses.

The shoulder of the plate should be high enough fully to engage the flanges of the rail base, and thus holding the rail firmly in place in the lateral direction. For this purpose double-shoulder plates are more satisfactory than the single shoulder design. The top or bearing area under the rail should be canted inward at the rate of 1:40 to give the tread of the wheel a full bearing on the running surface of the rail. Holes must be provided for the spikes that hold the rail. These are usually four in number, and from two to four additional holes are usually provided for hold-down spikes.

When tie plates rolled from soft steel are used on softwood ties they display a tendency to bend, thereby giving the base of the rail an uneven bearing surface, which is highly objectionable, while the distorted plate also tends to damage the tie upon which it is applied. On the other hand, the steel should not be too hard, to avoid the possibility of breaking the tie plate. Instead of these extremes, medium steel conforming to the requirements of the A.R.E.A. standard should be used.

Should It Be Redriven?

Where an entire pile bent of a ballast-deck trestle requires renewal, is it preferable to redrive it or to erect a frame bent? Why? How should the work be done?

Puts Up Frame Bent

By H. R. Gilkey

Division Engineer, Central of Georgia, Savannah, Ga.

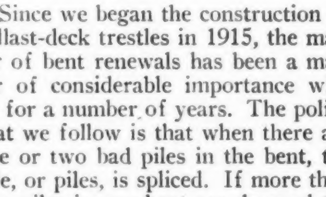
Since we began the construction of ballast-deck trestles in 1915, the matter of bent renewals has been a matter of considerable importance with us for a number of years. The policy that we follow is that when there are one or two bad piles in the bent, the pile, or piles, is spliced. If more than two piles in any bent are decayed the entire bent is cut down and a sill is applied.

We have found this to be much cheaper and just as substantial as driving a new bent. If piles were to be driven, it would be necessary to open the deck and shift the stringers, which would be expensive. However, when the sill is placed, the bent is well-braced and bolted to the bents on both sides with longitudinal bracing, and the bent itself is provided with sway bracing.

This work can be done in two ways, the choice depending on the density of the traffic. If the traffic is not too heavy, and the main part of the work can be done between trains, we often saw the piles off at the ground line and apply temporary braces to hold the sawed pile or piles in place while passing a train over the structure at low speed. The new posts are then cut to the correct length, and in a few minutes the entire old bent can be removed and the sill placed and the posts set. It is an easy matter to lash the cap in place temporarily until the posts are set.

If the traffic is dense, it may be well to set up a temporary bent on each side of the bent to be removed. These bents will support the stringers and need only to be set on mud sills or blocking to support them.

In work of this character it is quite important that the earth around the piles be excavated to a sufficient depth so that the piles can be cut off low enough for the sills to be set into the ground. All exposed untreated surfaces of the cut-off piles should be well swabbed with hot creosote, and the ground should be back-filled around the excavated pile.



Depends on Age of Trestle

By W. C. Harman

Supervisor of Bridges and Buildings, Southern Pacific, San Francisco, Cal.

When it becomes necessary to renew an entire bent in a ballast-deck trestle, there are several things to be

considered. If the remaining bents in the trestle and the deck are considered to be serviceable for many years, or where the structure crosses a stream carrying debris, or it is on unstable ground, a standard pile bent should be driven.

When driving such a bent, under today's traffic conditions, it is considered safer and more expedient to drive a three or a four-pile bent on either side of the old bent, to carry the traffic while the change is being made. It will then be necessary to remove the ballast for about 45 ft. and place the track on timbers, loosen the deck plank and pull all of the drift bolts in both stringers and cap. The stringers can then be separated and the false bents driven, after which the cap can be removed.

If at all possible, the piles in the old bent should be pulled out. If this cannot be done, the new piles can be driven between them, using the same batter as that on which the old piles were driven to avoid throwing the new piles out of line in case they come into contact with the old ones. By following this method, the new pile bent should be good for the remaining life of the trestle.

On the other hand, a frame bent can be installed economically, to good advantage and with the minimum of interference with traffic, in a trestle that has already served for half or more of its life expectancy, provided it is in firm ground or spans a stream that carries no drift. Such a bent will serve satisfactorily for the remaining life of the trestle.

The replacement can be carried out by first placing false frame bents on either side of the old bent to support the deck. The old piles can then be sawed off carefully at a point well below the ground line, where they should be sound, and a sill should then be placed on them to receive the new bent. This bent should be preframed, with all parts fitted carefully so that the installation can be made quickly. The actual placing of the new bent can be done under flag protection without it being necessary to dig out any of the ballast, provided the job has been planned carefully.

Why Paint Wrinkles

What causes paint to wrinkle? Should the old paint be removed before repainting? Why? If not, how should it be treated?

Film May Be Too Thick

By Supervisor of Bridges and Buildings

In general, the wrinkling of paint films is somewhat akin to another defect in paint surfaces known as crawling or creeping.

Paint crawls or sags because of too thin a mixture, too heavy an application or insufficient brushing. It also occurs when paint is applied in cold weather and becomes chilled so that it does not flow freely or respond to brushing. In this case the paint film seldom hardens or dries as it should, remaining in a plastic or partially fluid state for a long time. Paint may also crawl if it is applied over a hard glossy surface to which it does not adhere well.

Wrinkling, which is generally rated as a special form of crawling, does not of necessity either crawl, creep or sag, which are characteristic of true crawling. The usual cause is the application of a coat that is too heavy, but not heavy enough to crawl, and is not brushed in sufficiently. This coat dries or hardens upon the surface in about the same time as a coat that is applied correctly, but which requires a much longer time to dry throughout. Then, if a following coat is applied before the drying has been completed fully, as further drying takes place the under part of the film, or perhaps the whole film, shrinks, causing the following coat or coats to wrinkle.

The trouble can be avoided easily by making certain that the paint is of the correct consistency for use on the surface to which it is to be applied, and that it is being brushed out to normal thickness. Another requirement that must be insisted on is that the following coat shall not be applied until the first coat has hardened sufficiently to insure that the defect will not occur.

Ordinarily, wrinkling does not impair the protective value of the paint film, provided the paint is of good quality. An inferior paint or one mixed in an inferior oil is never dependable under the most favorable circumstances and is probably still less so when it possesses this defect. On the other hand, it does greatly mar the appearance of the surface to which it is applied. In general, the removal of the old paint film is warranted on the grounds of appearance alone when the surface is to be repainted. It may be a necessity if the old paint was of an inferior quality. So far as I am informed, there is no other cure.

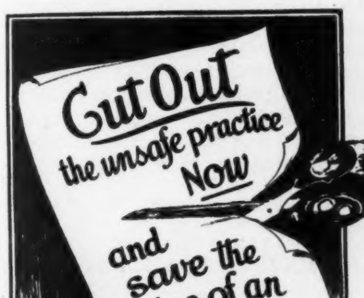
May Be Too Much Drier

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

Paint wrinkles when applied to a surface during wet or freezing weather, or when the surface is not perfectly dry. If a paint mixture that has too high a drier content is spread on even a dry surface, especially if applied during dry warm weather, it may sag or wrinkle because it does not have the consistency necessary for it to stay where it has been put. The same thing will happen if too heavy a coat is applied, even though the mixture is of correct consistency.

It is a waste of time and material to remove old paint that adheres securely to the original surface. All that is necessary is to remove loose and cracked paint and clean the surface so that the new paint will adhere to the prepared surface. However, where the old paint is cracking or peeling off to a large extent, it may pay, to insure a lasting job, to burn off the old paint in its entirety. This applies to previous poor paint jobs and to cases where the old paint surfaces have been neglected for long periods of time.

Some old paint surfaces will be encountered that will call for scraping or burning over sections where the paint does not adhere firmly. In such cases these areas must be cleaned of all dirt, scale, blisters and loose paint, and a suitable priming coat should then be applied, and when dry covered with succeeding coats.



This Poster, No. 266, Constitutes the November Installment of "All the Year—Every Year—Safety Program" of the Safety Section, Association of American Railroads.

Products of Manufacturers

Hystaway

THE Hyster Company, Portland Ore., has developed a combination dragline, clamshell and crane unit for tractor mounting, known as the Hystaway, which is said to permit a working combination of bulldozer, dragline, clamshell and crane. It is claimed that use of the bulldozer can be made without removing the Hystaway unit from the rear of the tractor, and, when full bulldozer production is desired, or other conventional uses of the tractor needed, that the unit can be removed in less than one hour. When again needed, the Hystaway unit can be installed on a tractor in about two hours. Full tractor mobility is said to be retained as crawler track operation is not impeded by the unit, and, furthermore, the unit can be easily transported from one job to another for installation in the field. The Hystaway is claimed to be comparable in production to any conventional unit for all types of shovel and crane work, and similar operations involving the handling of materials.

One of the Hystaway Units Installed On a Tractor, in Operation As a Dragline.

Koppers Grade Crossing

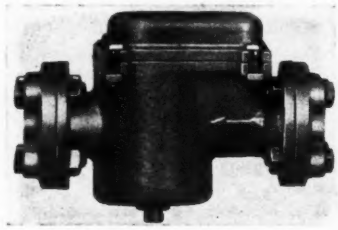
A NEW type of factory-assembled railroad-highway grade crossing of pressure-creosoted wood, ready for quick installation, has been developed by the Koppers Company, Inc., Wood Preserving Division, Pittsburgh, Pa. Crossings of this type are constructed of pre-fabricated panels in such manner that they distribute the highway wheel loads over the panels, and are said to be unaffected by vibration or by swelling or shrinking of the wood.

The panels are about 2 ft. by 8 ft. in plan, and 5⅛ in. thick, and are constructed of select hardwood. The timbers are machined to proper shape, pressure-treated with creosote against decay, and then tightly assembled into rigid panels with spiral dowels which grip along their entire length. The individual panels are light enough to be installed by hand and are attached to the ties with lag screws, thus permitting them to be removed while making track repairs and to be replaced without being damaged. Where the track rails are of 110-lb. section or less, the panels are attached directly to the ties. Where 112-lb. rail or heavier is involved, shims are inserted between the crossing panels and the ties.

A Koppers Grade Crossing, Consisting of 16 Pre-fabricated Panels

Blackmer Strainer

PRODUCTION of a new low-swing strainer, which was developed as a wartime measure to protect and conserve critical pumping equipment, has been announced by the Blackmer Pump Company, Grand Rapids, Mich. The new strainer has been added to the company's line of Ezy-Kleen strainers, and is available in a capacity of 100 gal. per min. with 2-in., 2½-in. and 3-in. intake and discharge sizes. The maximum operating temperature is 600 deg. F., and maximum pressure is 75 lb. per sq. in.



The New Blackmer Strainer

Among the advantages claimed for the new strainer is the use of perforated metal, steel or bronze, instead of wire screen for the strainer basket, which is said to make it less liable to damage during cleaning and to give it longer life. Another advantage is said to be the use of slotted lugs on the top plate, which line up with the lugs of the strainer body to receive the four holding nuts, thus permitting quicker removal of the basket for cleaning. Still another advantage is said to be its compact design, which permits mounting it in a small space or in lines along a wall. A fourth advantage claimed for the strainer is its design for flange mounting, and in line with this design companion flanges are included as a part of the unit.

NEWS of the Month

Another Tie Price Increase

An increase of $1.50 per 1,000 ft. b.m. in the mill ceiling prices of railway crossties manufactured in the "fringe area" east of the Rocky Mountains has been announced by the Office of Price Administration, effective October 3. The "fringe area" includes North and South Dakota, Utah, Wyoming, Colorado, Arizona, New Mexico, three counties in Oklahoma, west Texas and Mexico.

The O.P.A. also announced that manufacturers' ceiling prices on Port Orford cedar ties, previously authorized on individual application, have been placed in a table of prices in the regulation governing sales of crossties. As these prices have been in use by the tie industry since the issuance of the regulation, no changes will result from this action.

Freight Loadings to Drop

Freight car loadings in the fourth quarter of 1945 are expected to be 6.1 per cent below actual loadings in the same quarter of 1944, according to estimates compiled by the 13 Shippers' Advisory Boards. Decreases are anticipated in all territories except the Central Western, Trans-Missouri-Kansas and Pacific Coast.

Loadings, it is estimated, will be 8,548,720 cars in the fourth quarter of this year, compared with actual loadings of 9,105,017 for the corresponding period of last year. Large decreases are anticipated for such commodities as petroleum and products; machinery and boilers; ore; sugar, syrup and molasses; manufactures and miscellaneous; iron and steel and other commodities. Increases are forecast for citrus fruits, cement, grain, potatoes, agricultural implements and vehicles, canned goods, livestock and numerous food products.

Former U.P. Engineer Honored

Lt. Col. Channing M. Jordan, furloughed office engineer of the Utah division of the Union Pacific, formerly chief engineer of the Third Military Railway service, and now chief engineer of the Persian Gulf Command's military railway division, which is liquidating the affairs of the Third MRS, has received a letter of commendation for his services from Brigadier General Donald P. Booth, war-time commander of the Persian Gulf Command.

"As a result of a careful survey made by you during the months of February and March, 1943, and further, through your staff supervision, the tracks of the Iranian State Railway were restored to high standard of maintenance," wrote General Booth. "This resulted in increased tonnage and greater speed for trains transporting vital war material through the Persian Corridor."

Troop Movements To Become Heavier

The railroads will be faced with "the heaviest concentrated passenger load of the entire war", according to a statement by Colonel I. Sewell Morris, sixth zone transportation officer of the Army Transportation Corps, in an October 17 radio broadcast.

Col. Morris based his prediction on the fact that the Army will return from overseas assignments more than 3,000,000 troops in the next six months, while the Navy plans to bring home 2,500,000 of its personnel through Pacific ports between August, 1945, and next June. At the same time, Col. Morris continued, the services will demobilize hundreds of thousands of service people already in the country, ship 600,000 replacement troops to Europe and Japan, and repatriate more than 390,000 prisoners of war now being held in this country.

Concerning the possibilities of early restoration of sleeping cars to runs of 450 miles or less, Col. Morris pointed out that nearly half of the Army's personnel and virtually all of the Navy's men will be returned through Pacific ports, where about 90 per cent will require sleeper service for their journeys in this country. Consequently, he expects the sleeping car situation to remain tight for at least another six months before letting up.

Maintenance Man Honored, H. D. Knecht Heads Mission

H. D. Knecht, transportation engineer in the research department of the Missouri Pacific, at St. Louis, Mo., and formerly division engineer on that line at various points, has been named head of the newly created American Railroad Mission in Colombia, South America. In scope and functions, the mission is understood to be similar to the one to Mexico during 1942, 1943 and 1944, which acted in an advisory capacity in the task of rehabilitating the rail lines of that country.

Mr. Knecht entered the employ of the Missouri Pacific as a rodman at Atchison, Kan., in 1911, subsequently serving in that capacity at Osawatamie and Kansas City, Mo., before being transferred to St. Louis as assistant engineer in 1917. He became division engineer in 1925, being stationed successively at Coffeyville, Kan.; Little Rock, Ark.; St. Louis, and Kansas City. In April, 1943, he was promoted to the executive staff in the general offices, later being advanced to transportation engineer in the research department, where, among other investigations, he had charge of surveys and reports on increased mechanization of maintenance of way procedures. Outside of the maintenance field, he assisted in preparing the research committee report which led to the recent decision to purchase new lightweight passenger cars and Diesel locomotives to replace the present "Sunshine Special" trains operating between St. Louis and Memphis, Tenn., and Texas points.

Car Supply Remains Tight

Freight car conditions remain generally tight with nothing which can be called a surplus in hand or in sight for the next few months, according to the October report on the "National Transportation Situation," issued monthly by Warren C. Kendall, chairman of the Car Service Division of the Association of American Railroads.

Mr. Kendall said that due to heavy grain loadings resulting from this year's record crop and the export program calling for the shipment of 180 million bushels of grain to war-torn Europe at the rate of 30 million bushels a month, box cars, particularly of the better classification, are in great demand throughout the country for this purpose.

"Notwithstanding the substantial decrease in total carloadings for the country as a whole since V-J day, there has been relatively little decrease in the requirements for box cars," Mr. Kendall went on. "The continued co-operation of everyone in the prompt loading, unloading and expeditious handling of box cars will be of material assistance in meeting the obligations for this type of car."

Concerning demands for other types of freight equipment, Mr. Kendall said that livestock loadings continue to be heavy and are placing a "severe strain" on the available supply of stock cars. While labor troubles have reduced the demands for open-top cars and for automobile box cars, Mr. Kendall expects these types of cars to be in even greater demand than in recent weeks, once full production is resumed. Flat cars likewise continue in demand in spite of the virtual halting of export military shipments, due, he advised, to an increasing flow of inbound military equipment now being returned from the European and Pacific theaters of war.

Changes in Railway Personnel

General

Thomas E. Boyle, division engineer of the Philadelphia Terminal division of the Pennsylvania, at Philadelphia, Pa., has been promoted to superintendent of the Indianapolis division, with headquarters at Indianapolis, Ind.

Cedric S. Hill, assistant to manager of freight transportation of the New York Central, at New York, and an engineer by training and experience, has been advanced to superintendent stations and motor service with the same headquarters.

William H. Hamilton, general superintendent of the Montour railroad, has been promoted to vice-president—engineering, with headquarters as before at Corapolis, Pa. Mr. Hamilton will have general supervision of construction and maintenance of fixed property, real estate and material purchases and stores.

D. S. Hair, supervisor of contracts, operating department, of the Missouri Pacific, at St. Louis, Mo., and formerly assistant engineer at Wichita, Kan., has been promoted to transportation engineer, research section, succeeding **H. D. Knecht,** granted a leave of absence for government service in South America. Details of Mr. Knecht's appointment will be found in the general news columns of this issue.

N. N. Baily, whose promotion to general manager of the Reading with headquarters at Philadelphia, Pa., was reported in the October issue, was born

N. N. Baily

on August 8, 1903, and after graduation from the University of Pennsylvania he joined the Reading as leadman in the engineering department on October 1, 1925. One month later he became assistant supervisor of the Harrisburg division, being transferred to the Reading division the following March. In July, 1926, he became yardmaster of the Shamokin Division at Catawissa, Pa., and on March 1, 1928, he was named assistant to trainmaster of the Harrisburg division. One year later he was advanced to assistant trainmaster of the Reading division, and on July 1, 1933, he was named assistant superintendent of the Philadelphia division, being transferred to the Reading division in September, 1936. He was promoted to superintendent of the Reading division on December 1, 1939, and on November 16, 1944, he was appointed assistant general manager, the position he held at the time of this recent promotion to general manager.

Frederick McQ. Falck, whose retirement as assistant vice-president, personnel, of the Reading was reported in the October issue, was born on July 5, 1874, and joined the Reading as a work train laborer on the Shamokin division on January 1, 1898, later serving as assistant supervisor and as supervisor. In 1902 he was advanced to division engineer of the

Frederick McQ. Falck

Shamokin division, at Tamaqua, Pa., also serving in that capacity on the Reading division, at Reading, Pa. In 1910 he became assistant superintendent, subsequently occupying the positions of superintendent, assistant general manager and general manager, until December 1, 1936, when he was promoted to assistant vice-president, personnel.

Armstrong Chinn, general manager of the Alton and an engineer by training and experience, has been appointed chief executive officer of the Alton, with headquarters as before at Chicago. Mr. Chinn was born at Dallas, Tex., on September 26, 1894, and was graduated from Virginia Polytechnic Institute in 1916. He entered railway service in the latter year as an instrumentman of the Chicago, Burlington & Quincy on track elevation at Aurora, Ill. During 1918 and 1919 he served as a second lieutenant of field artillery in the American Expeditionary Force in France and then returned to the Burlington where he was engaged from 1919 to 1921 as an instrumentman on yard construction at La Crosse, Wis., and Centralia, Ill. In 1922 he was promoted to assistant engineer at Aurora, where he remained until 1923, when he became division engineer and roadmaster of the Quincy, Omaha & Kansas City (controlled by the C. B. & Q.), at Kansas City, Mo. Mr. Chinn was transferred back to the Burlington as roadmaster at Kansas City in 1925, and in the following year he was promoted to assistant engineer maintenance of way at Alliance, Neb. Early in 1927 he was promoted to district engineer maintenance of the Wyoming district, with

Armstrong Chinn

headquarters at the same point, and later in the year he was transferred to the Nebraska district with headquarters at Lincoln, Neb., and also placed in charge of work equipment. On December 1, 1929, Mr. Chinn was appointed chief engineer of the Alton, with headquarters at Chicago, and in March, 1943, he was promoted to general manager, the position he held at the time of his new appointment.

Engineering

G. L. Field has been appointed assistant engineer on the Canadian National, at Toronto, Ont.

Harold D. Van Vranken has been appointed chief engineer of the Jacksonville Terminal Company, with headquarters at Jacksonville, Fla.

H. Wuerth, division engineer of the Dubuque & Illinois division of the Chicago, Milwaukee, St. Paul & Pacific, at Savanna, Ill., has retired.

C. J. Wallace, supervisor of track on the Illinois Central, at Gilman, Ill., has been promoted to assistant engineer in the office of the chief engineer, with headquarters at Chicago.

L. C. Nesham, who was formerly division engineer of the Smith Falls division of the Canadian Pacific, at Smith Falls, Ont., has been appointed assistant engineer at North Bay, Ont.

A. F. Ewert, trainmaster on the Atchison, Topeka & Santa Fe, at Emporia, Kan., has been appointed trainmaster-division engineer at Chanute, Kan. **I. Anderson,** division engineer at Chanute, has resigned.

W. Waters, roadmaster on the Canadian National at Regina, Sask., has been promoted to division engineer, at Prince Albert, Sask., succeeding **H. R. Wilkinson,** whose transfer to Victoria, B. C., was reported in the September issue.

D. H. Shoemaker, construction assistant engineer on the Northern Pacific, at Livingston, Mont., has been appointed assist-

ant engineer at New Salem, N. D., a new position. The position of construction assistant engineer at Livingston has been abolished.

C. C. Robnett, division engineer on the Chicago, Burlington & Quincy, at St. Joseph, Mo., has been promoted to hydraulic engineer, with headquarters at Chicago. **F. O. Schafer,** an instrumentman at St. Joseph, has been advanced to division engineer succeeding Mr. Robnett.

John F. Swenson, who, because of ill health, has been on a leave of absence from his duties as division engineer of the Chicago Terminal division of the Pennsylvania, at Chicago, has been appointed division engineer—special duty, on the staff of the chief engineer maintenance of way of the Western region, with headquarters in Chicago.

Karl J. Wagoner, who was reported in the September issue as having been assigned to special duties on the Baltimore & Ohio, has been appointed chief engineer of the Lakefront Dock & Railroad Terminal, at Toledo, Ohio. This company is a subsidiary of the Baltimore &

Karl J. Wagoner

Ohio and the New York Central and will construct new coal docks at Toledo for use by these roads. Mr. Wagoner was born at Davis, W. Va., on December 21, 1892, and was graduated from W. Va. Wesleyan, Buckhannon, W. Va., in 1917. In June of the latter year he entered railway service as a rodman with the B. & O., and in October, 1918, he was advanced to field engineer, becoming assistant engineer at Pittsburgh, Pa., in April, 1926. He was further advanced to district engineer at that point in September, 1941, and one year later he was promoted to regional engineer at Pittsburgh, holding the latter position until his recent promotion.

M. C. Bitner, whose promotion to engineer maintenance of way of the Northwestern division of the Pennsylvania, at Chicago, was reported in the October issue, was born at DuBois, Pa., and was graduated in 1925 from the Carnegie Institute of Technology with the degree of B. S. in Civil Engineering. He entered railway service in 1926 as an assistant on the engineering corps of the Panhandle division of the Pennsylvania, at Pittsburgh, Pa., advancing to assistant track supervisor of the Renovo division in May, 1928. Two years later he was promoted to track supervisor on that division, serving subsequently on the Erie and Ashtabula, the Philadelphia and the Maryland divisions until April, 1940, when he was

M. C. Bitner

advanced to assistant division engineer of the New York division. The following year he was promoted to division engineer of the Erie and Ashtabula division, returning to the New York division in the same capacity, and holding the latter position until his recent promotion.

C. S. Sanderson has been appointed principal assistant engineer of the Atlantic Coast Line, at Wilmington, N. C. Mr. Sanderson was born on October 8, 1901, in Houlka, Miss., and was graduated from Mississippi State College in civil engineering in 1923. He entered the service of the Atlantic Coast Line as rodman the same year. Mr. Sanderson was appointed instrumentman in 1924 and resident engineer in 1925, then advanced to division engineer at Rocky Mount, N. C., in 1930. In 1933 he transferred to the Charleston & Western Carolina, a subsidiary of the A.C.L., as roadmaster at

C. S. Sanderson

Augusta, Ga., from which he was promoted to assistant superintendent of the same line in 1939. He entered the United States Army in 1942 as a lieutenant colonel, serving as staff officer in charge of the engineering section of the A. C. L.-sponsored 703rd Railway Grand Division Headquarters, spending 34 months in the European theater with that unit on reconstruction and maintenance of military railways in Africa, Italy, France and Germany. Mr. Sanderson was released from his army assignment on September 17, 1945, and his present appointment became effective October 1, 1945.

H. E. Wilson, division engineer of the Atchison, Topeka & Santa Fe, at Las Vegas, N. Mex., who has been on military leave of absence to serve with the 713th Railway Operating Battalion, has returned to his duties with the Santa Fe. **N. D. Bloom,** who has been division engineer at Las Vegas, has been transferred to Clovis, N. Mex., succeeding **W. R. Baker,** who has resumed his former position of roadmaster.

Ernest R. Shultz, whose appointment as chief engineer maintenance of way, Eastern region, of the Pennsylvania was announced in the October issue, was born in Kimmel, Pa., on October 25, 1903. He was graduated in 1924 from Pennsylvania State College with a B. S. degree in civil engineering. Mr. Schultz entered the service of the Pennsylvania that year as

Ernest R. Shultz

assistant, engineer corps, in the office of the division engineer at New Castle, Pa. In March, 1926, he resigned to accept a position as assistant city engineer there, which position he held until October, 1926, when he returned to the Pennsylvania in the capacity of chief draftsman at New Castle. In 1927 he was elevated to assistant supervisor of track, Pittsburgh division, later being transferred to the Eastern division, with headquarters at Alliance, Ohio. In 1929 he became supervisor of track, at Ravenna, Ohio, on the Cleveland division, and served in that capacity at various places until 1940, when he became a division engineer of the Columbus division. In 1942 Mr. Schultz was transferred to the Philadelphia terminal division, which position he filled until April, 1943, when he was assigned to special duty in the office of the chief engineer. In November, 1943, he was promoted to engineer maintenance of way, Northwestern division, and on September 16, 1945, to chief engineer maintenance of way, Eastern division.

F. P. Filippelli, division engineer of the Toledo division of the Pennsylvania, at

Toledo, Ohio, has been transferred to the Philadelphia division, at Harrisburg, Pa., succeeding **G. A. Williams,** who has been advanced to engineer maintenance of way of the Eastern Ohio division, with headquarters at Pittsburgh, Pa. Mr. Williams replaces **R. H. Crew,** who has been advanced to assistant to the chief engineer of the Central region, at Pittsburgh. **W. P. Conklin,** assistant division engineer of the Columbus division, at Columbus, Ohio, has been promoted to division engineer of the Toledo division, at Toledo, succeeding Mr. Filippelli.

George L. Morrison, whose promotion to assistant engineer maintenance of way and structures of the Southern Pacific, at San Francisco, Cal., was reported in the October issue, was born at LaJunta, Colo., on May 3, 1898, and is a graduate of the Rice Institute, Houston, Tex. He entered railway service with the Southern Pacific Lines in Texas and Louisiana, in September, 1913, occupying various positions in the transportation department at El Paso, Tex., and Houston, while attending high school and college. In July, 1923, he entered the engineering department of the Pacific lines as a rodman at Los Angeles, Cal., subsequently advancing to assistant engineer at that point. In October, 1938, he became general foreman, bridge and building department, at Los Angeles, and the following February he was further advanced to roadmaster at that point. In October, 1940, Mr. Morrison reentered the transportation department as assistant trainmaster at Calexico, Cal., becoming assistant terminal superintendent at Los Angeles in March, 1941. He was promoted to division engineer at Ogden, Utah, in October of that year, being transferred to Dunsmuir, Cal., on March 16, 1944, the position he was holding at the time of his recent promotion to assistant engineer maintenance of way and structures.

George L. Morrison

Carl T. Ray, senior assistant division engineer of the Rio Grande division of the Southern Pacific, at El Paso, Tex., has been promoted to division engineer of the Salt Lake division. **William J. Jones,** second assistant division engineer of the San Joaquin division has been advanced to senior assistant division engineer at El Paso, succeeding Mr. Ray. **Leland E. Lyon,** assistant division engineer at Oakland, Cal., has been transferred to the Tucson division at Tucson, Ariz.

James A. Blalock, whose promotion to assistant division engineer on the Richmond, Fredericksburg & Potomac, with headquarters at Alexandria (Potomac Yard), Va., was reported in the September issue, was born at Richmond, Va., on March 20, 1915, and graduated in civil engineering from Virginia Polytechnic Institute in 1937. Mr. Blalock entered railway service on June 14, 1937, as an engineering apprentice on the Pennsylvania at Philadelphia, Pa., later being transferred to Perryville, Md. In December, 1937, he was appointed assistant on the engineering corps at Perryville, and later served in that capacity at Baltimore, Md., and Norristown, Pa. He was promoted to assistant supervisor of track at Columbus, Ohio, in February, 1941, later being transferred to Pittsburgh, Pa. In December, 1941, Mr. Blalock went with the R. F. & P. as assistant supervisor of track at Fredericksburg, Va., later being transferred to Richmond. In August, 1944, he was appointed junior supervisor at Richmond, and in January, 1945, he was advanced to supervisor of track at Potomac Yard, which position he held until his recent promotion.

Track

F. Serviss, assistant roadmaster on the Canadian National at Cornwall, Ont., has retired.

J. L. Chouinard, roadmaster on the Canadian National, at Edmunston, N. B., has retired.

John D. Vaughan, section foreman on the M. & N. O. division of the Louisville & Nashville, has been promoted to assistant track supervisor, with headquarters at Pensacola, Fla.

R. W. Webb has been appointed roadmaster of the Maniwaki and Watham subdivisions of the Canadian Pacific, at Ottawa, Ont., succeeding **J. D. McGregor,** who has retired.

H. Huffman, acting supervisor of track on the Chicago & Eastern Illinois, at Danville, Ill., has been promoted to supervisor of track at Danville, succeeding **J. Smooth,** who has retired.

Earl E. Gordon has been appointed acting roadmaster of District No. 2 of the Bangor & Aroostook, with headquarters at Houlton, Me., succeeding **Arthur J. Long,** who has resigned because of ill health.

C. G. Johnson, formerly roadmaster on the Canadian Pacific at Golden, B. C., has been transferred to Fernie, B. C., replacing **T. J. Purdie,** whose appointment as roadmaster at Golden was reported in the October issue.

M. L. Bradbury, an instrumentman on the Galena division of the Chicago & North Western, at West Chicago, Ill., has been promoted to roadmaster at Casper, Wyo., succeeding **L. W. Eddy,** whose death is reported elsewhere in this issue.

Kelly James, assistant roadmaster on a system steel gang on the Chicago, Rock Island & Pacific, has been promoted to roadmaster at Washington, Ia., succeeding **R. L. Etherton,** who has been transferred to Trenton, Mo., replacing **J. H. Burns,** who has resigned.

A. L. Sams, assistant supervisor of track on the Kentucky division of the Illinois Central, has been advanced to supervisor of track at Gilman, Ill., succeeding **C. J. Wallace,** whose promotion to assistant engineer, at Chicago, is reported elsewhere in this issue.

W. N. Young, supervisor of track on the Memphis division of the Illinois Central, at Tutwiler, Miss., has been transferred to the Louisiana division, at Yazoo City, Miss., succeeding **Q. M. Young,** who has been transferred to Jackson, Miss., also on the Louisiana division, relieving **T. B. Greer.** Mr. Greer replaces W. N. Young at Tutwiler.

J. N. St. Pierre, roadmaster of the Renfrew subdivision of the Canadian National, has been transferred to the St. Jerome division, with headquarters at Montreal, Que., succeeding **J. H. Plante,** who has been transferred to Richmond, Que. Mr. Plante replaces **J. D. Sauve,** who has been transferred to the Renfrew subdivision, relieving Mr. St. Pierre.

R. E. Miller, supervisor of track on the Toledo division of the Pennsylvania, at Carrothers, Ohio, has been transferred to the Ft. Wayne division, at Warsaw, Ind., succeeding **C. R. Merriman,** who has resigned. **H. J. Preston,** assistant supervisor of track on the Baltimore division, has been promoted to supervisor of track at Carrothers, relieving Mr. Miller.

Elmer L. Banion, assistant superintendent on the Atchison, Topeka & Santa Fe, at Needles, Cal., has returned to the general manager's office, eastern lines, at Topeka, Kan., and has been assigned to special duties. The position of assistant superintendent at Needles has been abolished. **C. M. Richardson,** general track foreman at Topeka, has been made roadmaster at Marceline, Mo., succeeding **A. Youngblood,** who has been appointed supervisor of track.

Merritt L. White, whose promotion to roadmaster on the St. Louis-San Francisco, at Springfield, Mo., was reported in the October issue, was born at Elmwood, Tenn., on December 31, 1902. He entered the employ of the Frisco in 1926 as a section laborer, and one year later he was advanced to section foreman. Since that time he has served in that capacity and as extra gang foreman at various points, and at the time of his recent promotion was section foreman at Poteau, Okla.

N. Olsen, supervisor of track on the Maryland division of the Pennsylvania, at York, Pa., has been transferred to the Philadelphia Terminal division, at Philadelphia, Pa., succeeding **H. J. Lattomus,** who has resigned. **Wilmer Wallace,** assistant supervisor of track on the Maryland division, at Washington, D. C., has been promoted to supervisor of track at York, replacing Mr. Olsen, and **W. W. Worthington,** who has returned from military service, has been appointed assist-

(Continued on page 1174)

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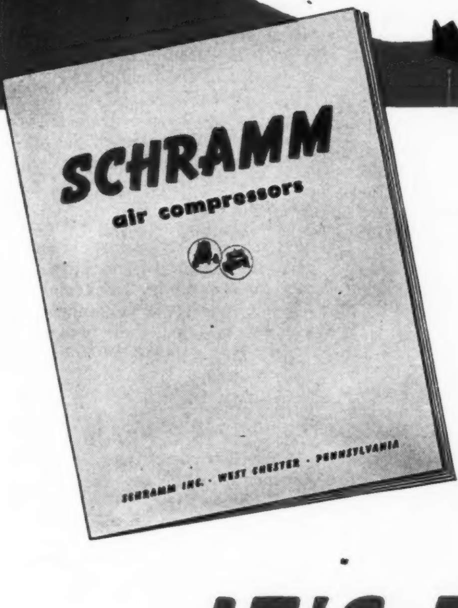

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ant supervisor of track at Washington, D. C., relieving Mr. Wallace.

M. H. McCully, supervisor of track on the Buffalo division of the Pennsylvania, at Mt. Morris, N. Y., has been transferred to the Erie and Ashtabula division, at Sharon, Pa., succeeding **J. C. Dayton,** incapacitated. **R. D. Jordan,** Jr., assistant supervisor of track at Freedom, Pa., has been advanced to supervisor of track at Orrville, Ohio, succeeding **P. J. Harnish,** who has been transferred to Alliance, replacing **C. G. Lybarger,** who has been transferred to Carnegie, Pa. Mr. Lybarger relieves **T. D. Market,** who, in turn, succeeds Mr. McCully at Mt. Morris.

E. S. Hughes, assistant roadmaster on the Scioto division of the Norfolk & Western, has been promoted to roadmaster of the Tug Fork branch, at Wilcoe, W. Va., succeeding **D. K. Wickham,** who has been transferred to the Dry Fork branch at Iaeger, W. Va., replacing **W. L. Goodman.** Mr. Goodman relieves **Harmon Maynard,** who has retired as roadmaster on the Pocahontas division at Williamson, W. Va. Mr. Hughes entered the employ of the Norfolk & Western as a track man on the Shenandoah division in April, 1931. In 1934 he was promoted to relief foreman, and in 1940 he was further advanced to section foreman. Two years later he became inspector, office of manager roadway maintenance, and later that same year he was named assistant roadmaster on the Radford division, transferring to the Scioto division in April, 1945.

B. S. Buskovick, whose promotion to roadmaster on the Chicago, Rock Island & Pacific at Rock Island, Ill., was reported in the October issue, was born at Medford, Minn., on April 27, 1903, and, after a high school education, entered railway service on May 1, 1919, as a section laborer on the Rock Island. In 1923 he was promoted to section foreman, later serving as yard and extra gang foreman and as track inspector. In July, 1941, he was furloughed to the James Construction Co., to serve as general foreman of construction, in charge of building new tracks at the Gopher Ordnance plant, Rosemont, Minn., returning to the Rock Island in November of that year. Mr. Buskovick was advanced to assistant roadmaster on a system steel gang in April of this year, later being appointed assistant roadmaster at Bureau, Ill., the position he was holding at the time of his recent promotion.

Bridge and Building

A. Bechamp has been appointed assistant bridge and building master of the St. Laurent division of the Canadian National.

Walter V. Allen, bridge inspector on the Chesapeake & Ohio, at Catlettsburg, Ky., has been promoted to assistant supervisor of bridges and buildings at Columbus, Ohio.

T. J. Atkinson, assistant master carpenter on the Panhandle division of the Pennsylvania, at Pittsburgh, Pa., has been promoted to master carpenter of the Chicago Terminal division, at Chicago, succeeding **H. H. Williams,** who has resigned. **C. G. Hill,** a carpenter foreman on the Chicago Terminal division, has been promoted to assistant master carpenter on the Panhandle division, at Pittsburgh, replacing Mr. Atkinson.

Harry L. Porter, assistant foreman of a system steel gang on the Southern Pacific, has been promoted to assistant supervisor of bridges and buildings on the Salt Lake division, at Ogden, Utah.

William H. Begeman, whose promotion to supervisor of bridge and buildings of the Joplin and White river division of the Missouri Pacific, at Nevada, Mo., was reported in the October issue, was born at Morrison, Mo., on September 11, 1891. After a public school education, he entered railway service as a bridge and building laborer on the Eastern division of the Missouri Pacific, subsequently advancing to helper and to carpenter. He was promoted to bridge and building foreman in 1916, and on July 1, 1942, he was further advanced to assistant supervisor of bridges and buildings on the Omaha and Northern Kansas division, at Falls City, Neb., the position he held at the time of his recent promotion.

Water Service

Noah Newsome, supervisor of water supply of the Russell, Ky., terminal of the Chesapeake & Ohio, has been transferred to the Hocking division, at Columbus, Ohio, succeeding **S. W. Price,** who has been assigned to other duties. **Roy L. Cooper,** a waterworks foreman, has been promoted to supervisor at Russell, relieving Mr. Newsome.

Special

Rolf Thelen, chief of the timber physics division of the Forest Products Laboratory of the United States Department of Agriculture at Madison, Wis., has retired.

Obituary

L. W. Eddy, roadmaster on the Chicago & North Western, at Casper, Wyo., died in that city on October 6.

Anthony F. Maischaider, whose retirement as principal assistant engineer of the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), at Cincinnati, Ohio, was reported in the June issue, died in that city recently, at the age of 62.

A. L. Kleine, trainmaster on the Denver & Rio Grande Western, at Gunnison, Colo., and an engineer by training and experience prior to entering the operating department, died in the Rio Grande Hospital at Salida, Colo., on October 11.

Barco Tytmaper—A catalog, No. 656, issued by the Barco Manufacturing Company, Chicago, describes the advantages of its new Tytamper, Model TT-3, and tells of the improvements and changes which have made over former models to improve performance and make it entirely self-contained.

Association News

Roadmasters' Association

Printer's delays have prevented the prompt mailing to all members of a report of the one-day annual meeting of the association in Chicago on September 12, but it is expected that copies of this report will go out shortly after the first of November, to be followed closely by duplex mailing cards whereon members will be asked to indicate their choice of subject assignments for study in 1946. It is urged by the officers of the association that members return these cards promptly so that the final selection of committee personnel can be made at a meeting of the Executive committee to be held in Chicago on December 3.

Bridge and Building Association

Since there will be no Proceedings published covering the one-day annual meeting of the association, held in Chicago on October 17, reported on in full in this issue of *Maintenance,* the Executive committee is planning to mail to all members a reprint of the Bridge and Building section of this issue, just as soon as such reprints can be prepared. It is expected that this will be toward the latter part of November, when members will also be asked to indicate their choice of subject assignments for study in 1946. It will be essential that members advise their preferences in this latter regard promptly so that the Executive committee, at a meeting to be held in Chicago on December 17, can select the personnel of all committees and get their work under way promptly.

American Railway Engineering Association

Only two committees are making plans for meetings in November. The Committee on Wood Bridges and Trestles has scheduled a meeting to be held at Chicago on November 6, while the Committee on Track is making plans for a meeting to be held late in the month.

During October six committees held meetings, including the Committee on Maintenance of Way Work Equipment, which met at Chicago on October 9; the Committee on Co-Operative Relations with Universities, which met at Chicago on October 16; the Committee on Water Service, Fire Protection and Sanitation, which also met at Chicago on the sixteenth; the Committee on Masonry, which held a meeting at Detroit, Mich., on October 17 and 18; the Committee on Rail, which met at Chicago on October 24; and the Committee on Records and Accounts, which met at Buffalo, N.Y., on October 24 and 25.

The November Bulletin of the Association, which will be distributed to the members during the month, will include the reports of a number of committees and will also embody a reprint of a research report on the electrolytic corrosion

(Continued on page 1176)

7 TOURNAPULLS speed reconstruction on Santa Fe

MODERN OFF-TRACK METHOD 3-MILE GRADE REALIGNMENT USED TO HANDLE 900,000 CU. YD.

To reduce curves from 4 to 1° and increase train speeds from a maximum 50 to 105 mph on its double-track mainline between Elmer and Cardy, Mo. the Santa Fe contracted with Cameron-Joyce and O'Dell-Riney to move 800 to 900,000 cubic yards. One fill alone (see sketch) calls for 250,000 yards to maintain 0.8% grade.

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Here, 7 Tournapulls with 15-yard Carryalls are working on a 975' one-way haul, over a 10% grade from cut to fill. Despite steep grade, sticky clay and shale, each Tournapull is averaging 11 trips of load, haul, spread and return per hour.

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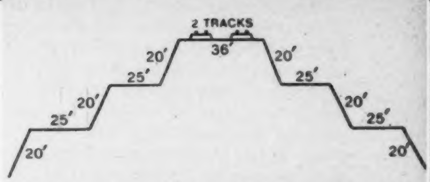

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of steel in concrete, which was prepared for the Committee on Electrolysis of the Electrical section, Engineering division, A.A.R. The committee reports to be published in the November Bulletin will include those of the Committees on Water Service, Fire Protection and Sanitation; Economics of Railway Location and Operation; Highways; Yards and Terminals; Waterways and Harbors; and possibly one other.

Wood Preservers' Association

President J. H. Bremicker has announced that a three-day annual meeting of the association will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, on April 23, 24 and 25. Tentative plans for the meeting call for business sessions during both the morning and afternoon of the 23rd and on the mornings of the 24th and 25th, with a banquet on the night of the 24th.

General Chairman A. E. Larkin of the association's Committee on Handling of Forest Products reports that the committee has finished the first part of its assignment, namely, the making of a complete survey of existing methods of loading and unloading ties. The next phase of its assignment will be to complete plans for employing engineering talent to design and develop additional mechanical devices as may be necessary to improve present methods of handling ties, and at the same time to solicit contributions from the producers and users of ties and other forest products to support this engineering work.

Maintenance of Way Club of Chicago

With an attendance of 175 members and guests, the first fall meeting of the club was held on Monday evening, October 22, in the Ambassador Room of Huyler's Restaurant, Chicago. Following dinner, the meeting was addressed by Col. John W. Wheeler, executive assistant of the Chicago, Burlington & Quincy, and until recently chief engineer of the 16th Corps, United States Army, serving with the invasion forces in France, Belgium, Holland and Germany. Col. Wheeler painted a vivid picture of the invasion of Europe and of the condition of the German railways immediately prior to and on V-E Day, illustrating his remarks with a number of lantern slides.

The next meeting of the club, to be held on November 26, will be addressed by C. H. Mottier, vice-president and chief engineer of the Illinois Central System, who will speak on "Looking Ahead in Railroading." It is expected that Mr. Mottier will treat this subject primarily from a managerial standpoint, but, at the same time, will cite some of the forward-looking plans and programs being carried out and in prospect on the Illinois Central.

Rooflex—The Flexrock Company, Philadelphia, Pa., has published a folder describing Rooflex, a product used for preserving new roofs or restoring old ones. The folder, which is well illustrated, also describes the various methods of application.

Supply Trade News

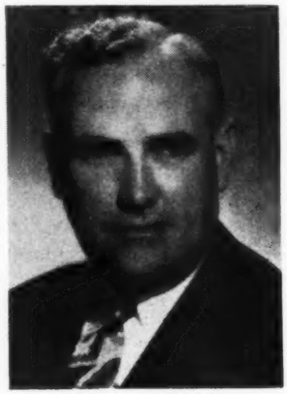
General

The American Lumber & Treating Co., Chicago, has announced plans for a new treating plant at Florence, S.C. The new plant will be served by the Atlantic Coast Line and Seaboard railways.

Personal Mention

J. R. Burkey, consulting engineer and personnel director of the **Union Metal Manufacturing Company,** Canton, Ohio, has established his office at 2421 Plymouth Avenue., Columbus 9, (Bexley) Ohio.

Guy J. Coffey, manager of the Los Angeles district office of the **Chicago Pneumatic Tool Company,** has been elected vice-president in charge of sales, with headquarters at New York. Mr. Coffey was born in Champaign, Ill., and began his business career with the Ohio



Guy J. Coffey

Steel Foundry Company, Lima, Ohio. In 1919 he became plant engineer of the Detroit Steel Casting Company, holding this position until 1930, when he was appointed special sales engineer of Black & Decker Manufacturing Company. In 1933 he went with the Chicago Pneumatic Tool Company, as a salesman at Philadelphia, Pa., subsequently being transferred to Cleveland, Ohio. Mr. Coffey was advanced to manager of the Los Angeles district sales office in 1939, remaining in this position until his recent appointment.

R. N. Landreth, special representative of the **Allis-Chalmers Manufacturing Company,** with headquarters at Washington, D.C., has been promoted to assistant to the vice-president. He will continue to reside in Washington but will function on assignments from Milwaukee.

Emanuel Woodings, president of the **Woodings Forge & Tool Co.** and of the **Woodings-Verona Tool Works,** Verona, Pa., has been elected executive chairman of the board of these companies, with headquarters as before at Verona, Pa. **Wilbert H. Woodings,** vice-president of these companies, at Verona, has been elected president, succeeding Emanuel Woodings.

F. B. Horstmann, technical director of the railroad department of the **Dearborn Chemical Company,** has retired after 40 years of service.

Charles H. Morse, III, president of the **Inland Utilities Company,** a subsidiary of **Fairbanks, Morse & Co.,** has been elected also vice-president in charge of research, traffic, patents and the western pump division of Fairbanks, Morse, with headquarters at Chicago.

The headquarters of the **O'Neall Division** of the **Armco Drainage Products Association** have been moved from Chicago to South Bend, Ind., and **Ken C. Thomas,** manager of the division has moved to South Bend. An office has been established in the St. Joe Bank building in the latter city, and negotiations are being completed for a site to build a new fabricating plant there. The headquarters of **Russell G. Betts,** railway representative, and **C. D. Beerup,** sales engineer, will remain at Chicago.

E. W. Scripture, who has been on leave of absence from his position as director of research of the **Master Builders Company,** Cleveland, Ohio, to serve as a lieutenant colonel with the United States Army Engineers, has returned to civilian status and resumed his former position with the Master Builders Company. Col Scripture entered the service in 1942 and was assigned to the office of the chief engineer, European theater. He served in England for two years, until August, 1944, when he was sent to France. He was awarded the Purple Heart, Bronze Star and Legion of Merit.

Herbert B. McKean, formerly of the U.S. Forest Products Laboratory, has been appointed assistant to the director of research of the **Timber Engineering Company,** Washington, D.C. Mr. McKean was graduated from the New York State College of Forestry, Syracuse, N.Y., in 1933. He remained on a fellowship and was awarded the master of forestry degree in 1934. He subsequently was employed with the T. J. Moss Tie Company, St. Louis, Mo., and later joined the faculty of Louisiana State University, teaching wood technology and use. He was graduated with a doctor's degree from Michigan University in 1941, and was appointed technologist at the Forest Products Laboratory in 1942.

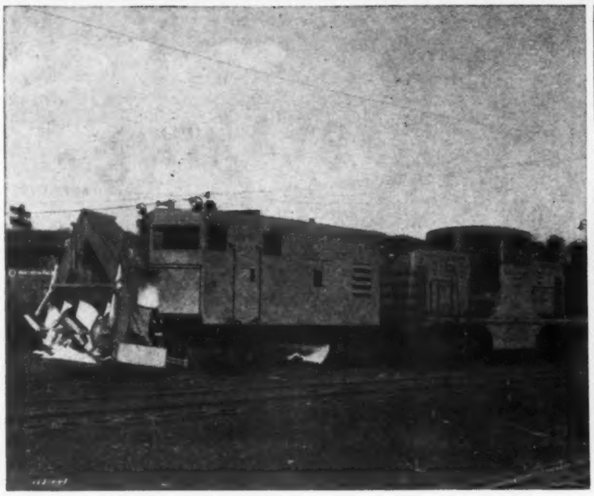
Obituary

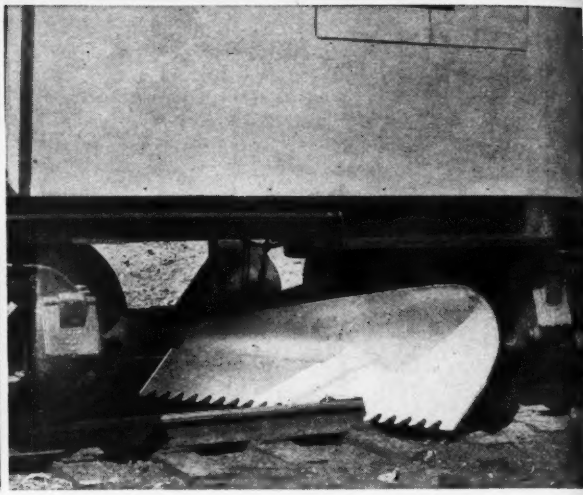
Charles F. Fitts, president of the Rodger Ballast Car Company, Chicago, died at his home in that city on October 17.

George S. Bartlett, assistant to the chairman of the board of the Portland Cement Association, died at his home in Chicago on October 21, at the age of 87, after a long illness.

A. M. Nardini, who for the last 35 years has been vice-president of the Railway Track-Work Company, Philadelphia, Pa., died of a heart attack in that city on October 19, at the age of 63.

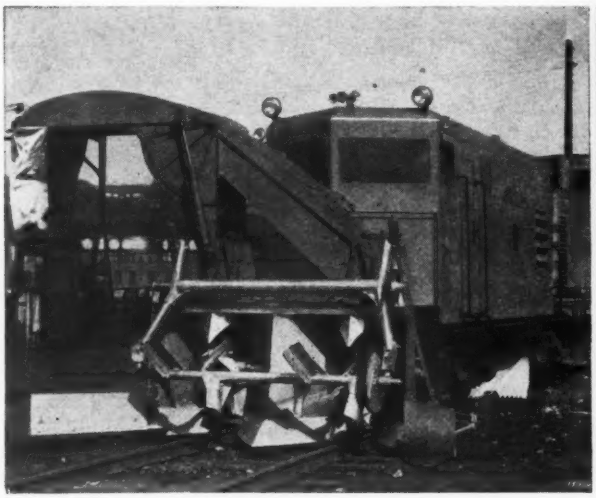
RAILROADS ASKED FOR IT

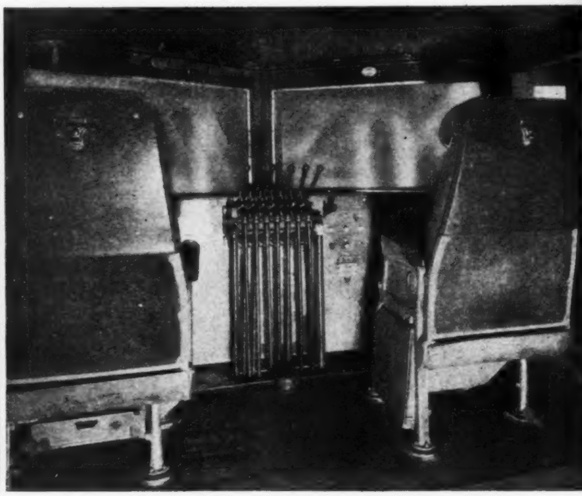




THE NEW BROS ROTARY PLOW keeps main lines open, working effectively in six to eight feet of snow, throwing it to either side of the track a distance of 75 to 100 feet with the wind.

WITH "V" TYPE ICE SCARIFIER ATTACHED, open stations and switch yards can be cleared of ice, the scarifier being used to loosen the ice and the plow pushing it to the sides of the track.





FOR COLLECTING AND LOADING, in switch yards and open stations, side wings collect the ice and snow and deliver it to the rotary. A loading chute permits easy side loading into cars or trucks.

HYDRAULIC CONTROLS are conveniently grouped within the wide vision cab, which simplifies the operator's handling of the entire unit. Wm. Bros Boiler & Mfg. Company, Minneapolis 14, Minn.

Give us your Snow Problems—we'll give you the answer

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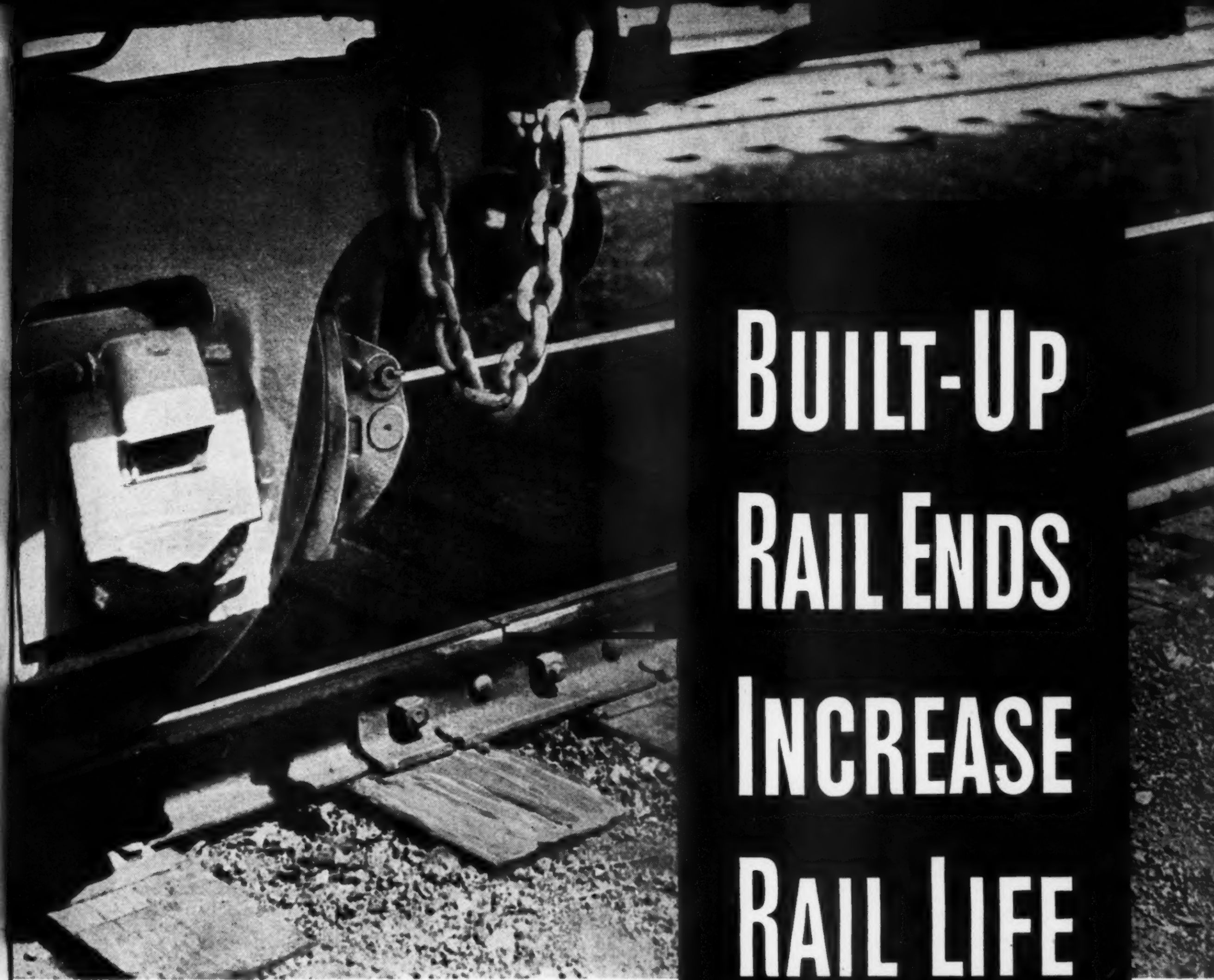

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FREE!

Wire brush and tamper with initial 55-gal. drum order.

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Builders of the Most Complete Line of
SHOVELS-CRANES-DRAGLINES

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(A DIVISION OF LINK-BELT COMPANY)

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HERE'S a ductway which effectively withstands the corrosive action of all types of soil normally encountered in cable installation.

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It enables one smith alone to do the work of a smith and two helpers.

It uses the smith's familiar hand tools and methods.

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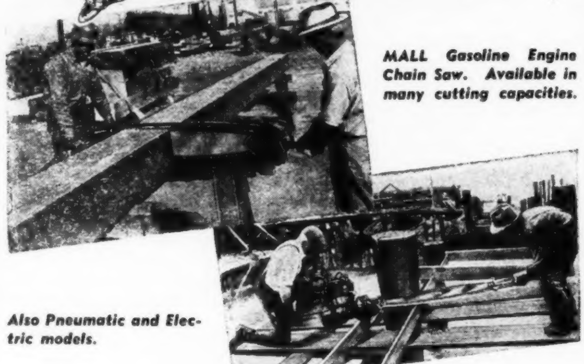

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Of Railway Engineering and Maintenance, published monthly at Chicago, Ill., for October 1, 1945.

State of Illinois }
County of Cook } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Neal D. Howard, who, having been duly sworn according to law, deposes and says that he is the Editor of the Railway Engineering and Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Simmons-Boardman Publishing Corp., 105 West Adams St., Chicago 3, Ill. Editor, Neal D. Howard, 105 West Adams St., Chicago 3, Ill. Managing Editor, Merwin H. Dick, 105 West Adams St., Chicago 3, Ill. Business Manager, S. Wayne Hickey, 105 West Adams St., Chicago 3, Ill.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is........... (This information is required from daily publications only.)

N. D. HOWARD, Editor.

Sworn to and subscribed before me this 24th day of September, 1945..

[SEAL.] RALPH E. WESTERMAN,

(My commission expires February 3, 1949.) Notary Public.

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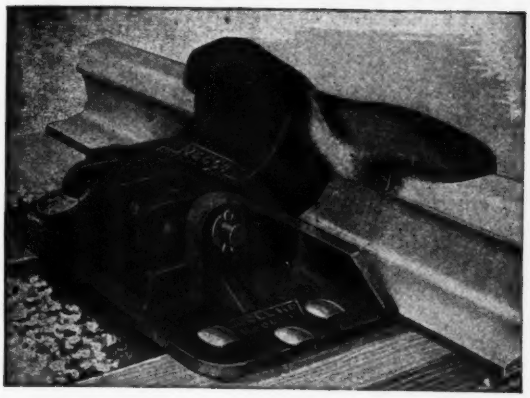

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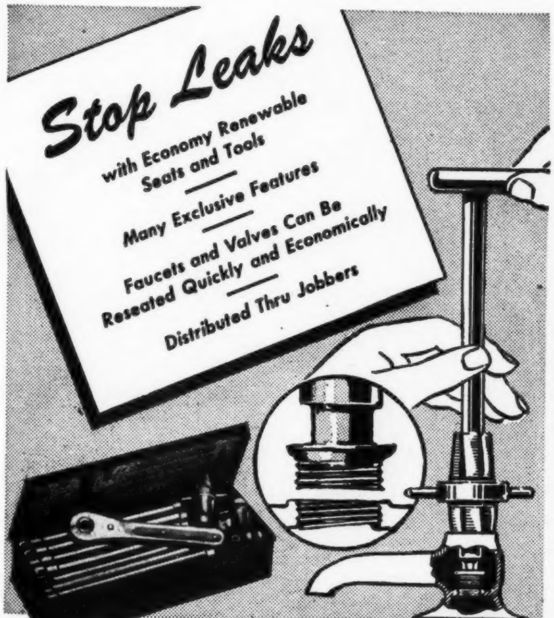

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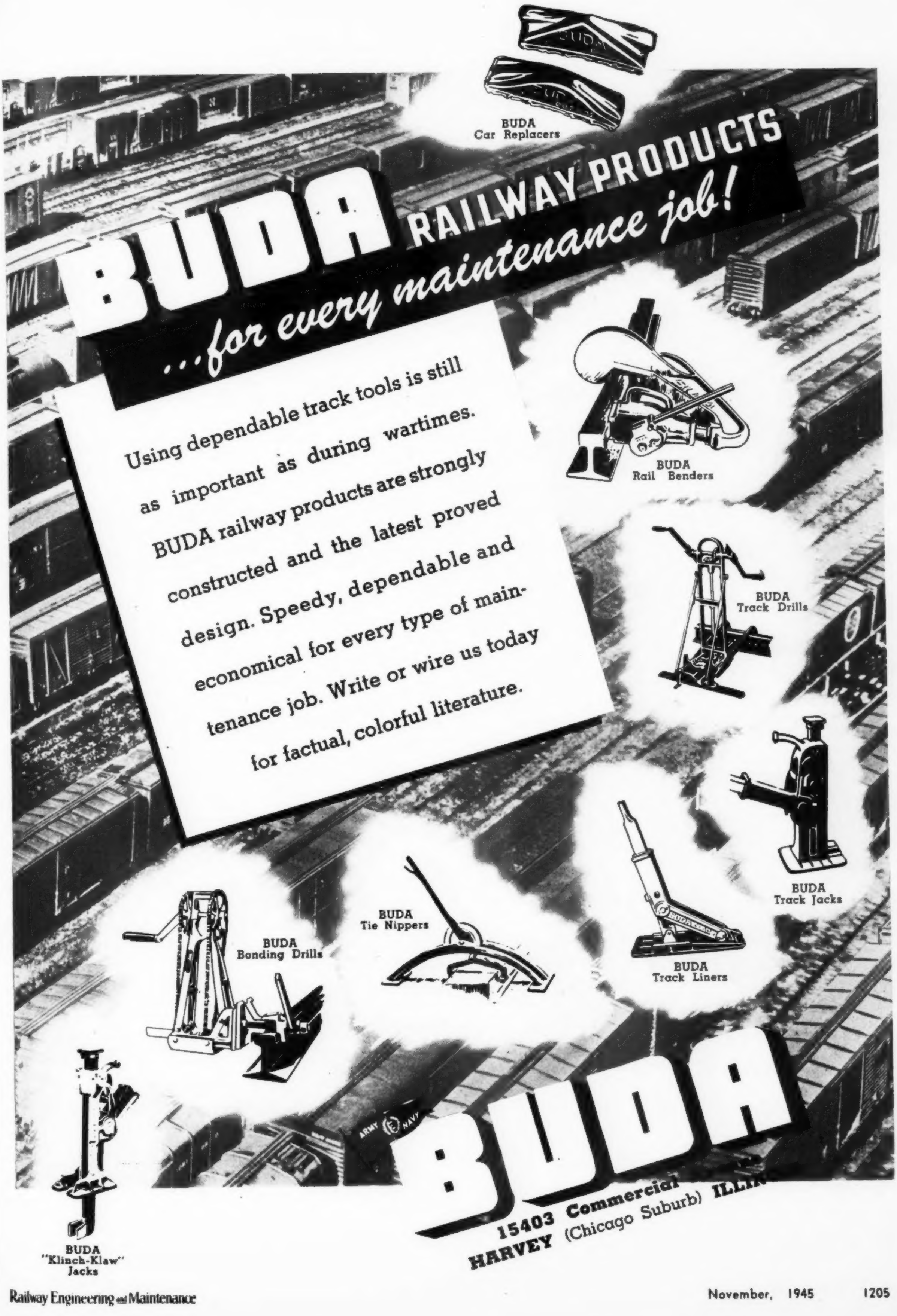
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